

SOIL SURVEY

Dawson County Texas



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
TEXAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of Dawson County will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields. It will assist engineers in selecting sites for roads, buildings, ponds, and other structures; and it will add to soil scientists' fund of knowledge.

In making this survey, soil scientists walked over the land. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noticed differences in the growth of crops, weeds, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming, ranching, engineering, and related uses.

The soil scientists plotted boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of the report. Fields, roads, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil, wherever it appears on the map. Suppose, for example, an area located on the map has the symbol AfA. The legend for the detailed map shows that this symbol identifies Amarillo fine sandy loam, 0 to 1 percent slopes. This soil and all others mapped in the county are described in the subsection, Descriptions of Soils.

Finding information

Few readers will be interested in all of the report, for it has special parts for different groups. The section, General Nature of the Area, which discusses climate, early history, natural resources, agriculture, and other subjects, will be of interest mainly to those not familiar with the county.

Farmers and those who work with farmers will want to learn about the soils in the sub-

section, Descriptions of Soils, and then go to the section, Use and Management of Soils. In this way they first identify the soils on their farms and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability units; that is, groups of soils that need similar management and respond in about the same way. For example, Amarillo fine sandy loam, 0 to 1 percent slopes, is shown to be in capability unit IIIe-2, if the soil is dry-farmed and in capability unit IIe-2, if it is irrigated. The management for this soil is given under the heading, Capability unit IIIe-2 (IIe-2, irrigated) in the section, Use and Management of Soils.

Ranchers will find the range site named for each soil in the subsection, Descriptions of Soils. In the subsection, Range Sites, the climax vegetation for each range site is given. A range site is a management group of soils used for range.

Soil scientists will find information about how the soils were formed and how they are classified in the section, Formation, Classification, and Morphology of Soils.

Engineers will find information that will assist them in the subsection, Descriptions of Soils, and in the section, Engineering Applications.

Students, teachers, and other users can learn about the soils and their management in various parts of the report, depending on their particular interest. Those interested in general soil areas will want to read the subsection, General Soil Map. This section tells about the principal kinds of soils and where they are found.

* * *

This soil survey was made as a part of the technical assistance furnished by the Soil Conservation Service to the Dawson County Soil Conservation District. Help in farm planning can be obtained from members of the SCS in the district, the county agricultural agent, or the staff of the State Agricultural Experiment Station. Fieldwork for the survey was finished in 1957. Unless otherwise indicated, all statements in the report refer to conditions in the county at the time the fieldwork was in progress.

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SOIL SURVEY OF DAWSON COUNTY, TEXAS

SOILS SURVEYED BY DUPREE SANDERS, IN CHARGE, KELLY M. TEMPLETON, HORACE E. MITCHELL, WILLIAM M. MILLER, CLIFFORD J. NOVOSAD, AND BILLY J. WAGNER, SOIL SCIENTISTS, SOIL CONSERVATION SERVICE

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

DAWSON COUNTY is in the extreme southern part of the high plains in the Great Plains Province. Lamesa, the county seat, is on U.S. Highway 180, about halfway between Fort Worth and El Paso. It is 60 miles south of Lubbock, in Lubbock County (fig. 1).

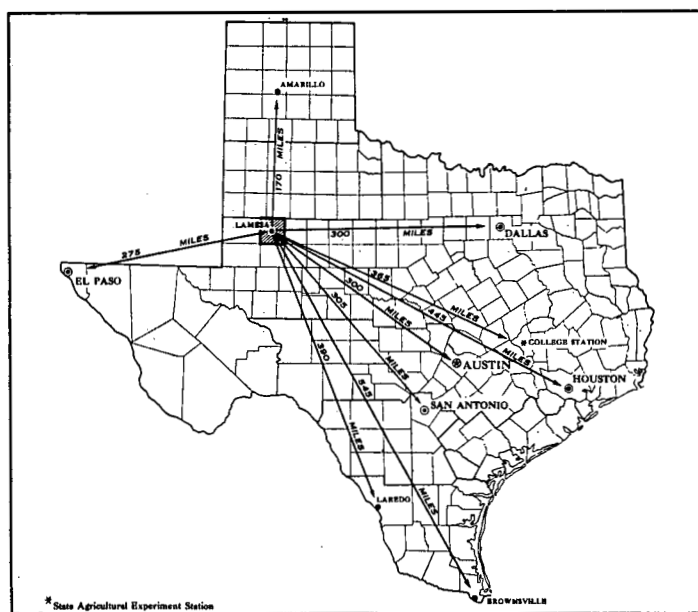


Figure 1.—Location of Dawson County in Texas.

The county is square shaped, about 30 miles on a side, and covers about 575,360 acres. It has long been recognized as one of the outstanding dry-farming counties in the State. In the last 50 years huge cattle ranges have given way to more intensive use by farmers. Cotton and grain sorghum are the main crops.

Soils of Dawson County

This section consists of three main parts. The first part describes general soil areas, or soil associations, in the county; the second part discusses the effects of wind erosion; and the third part describes the individual soils.

General Soil Map

Figure 2 is a general soil map of Dawson County. This map shows that the soils of the county are in two general kinds of landscapes—high plains and rolling plains. The rolling plains are in two areas in the eastern part of the county that together make up slightly more than 10 percent of the county. The high plains occupy the rest of the county.

On the general soil map, lines are drawn around the seven general soil areas, or, as they are called in this report, soil associations. A knowledge of these soil associations is useful to those who want only general ideas about the soils, or wish to compare different parts of the county, or want to locate large areas that are suitable for some broad land use.

Table 1 lists, for each soil association, the approximate acreage in cropland, in rangeland, and the total area.

TABLE 1.—Acreage according to use and total acreage of each soil association in Dawson County, Tex.

Landscape and soil association	Cropland	Range and pasture	Total area
High plains:			
Deep sands: Tivoli-Brownfield	Acres 0	Acres 8,000	Acres 8,000
Sandy soils: Brownfield-Amarillo	¹ 134,000	28,000	162,000
Mixed land: Amarillo	² 217,000	33,000	250,000
Limy soils: Portales-Arch	³ 27,500	2,500	30,000
Hard land: Amarillo-Portales	52,000	5,000	57,000
Rolling plains:			
Shallow or steep soils: Mansker-Potter	9,000	36,000	45,000
Deep soils: Bippus-Abilene	500	17,500	18,000

¹ Includes 34,000 acres of irrigated cropland.

² Includes 15,000 acres of irrigated cropland.

³ Includes 3,000 acres of irrigated cropland.

Soil associations on the high plains

The high plains are much more extensive than the rolling plains and have a wider variety of soils. Sandy soils are in the western part of the county on the high

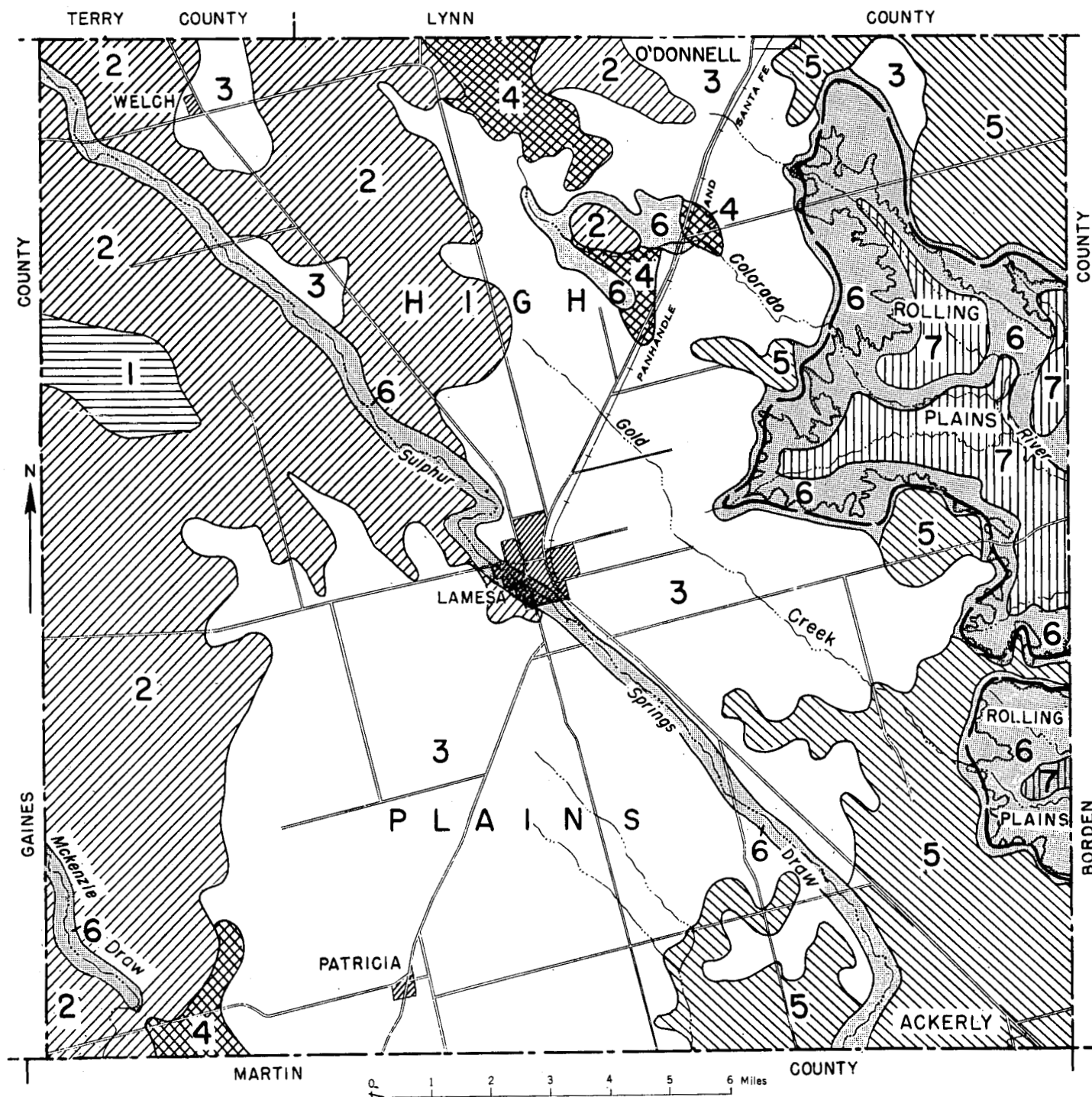


Figure 2.—General Soil Map, Dawson County, Texas. The heavy broken lines that parallel the escarpment in the eastern part of the county is the boundary between the high plains and the rolling plains.

Soils on the high plains:

- (1) Deep sands: Tivoli-Brownfield.
- (2) Sandy soils: Brownfield-Amarillo.
- (3) Mixed land: Amarillo.
- (4) Limy soils: Portales-Arch.
- (5) Hard land: Amarillo-Portales.

Soils on the rolling plains:

- (6) Shallow or steep soils: Mansker-Potter.
- (7) Deep soils: Bippus-Abilene.

elevations. Various soils, called Mixed land on the general map, extend north and south through the middle of the county. The soils in this area are mostly fine sandy loams. In the eastern part of the high plains, clay loams are widespread. Limy soils occur in the north-central and southwestern parts of the county.

1. **DEEP SANDS: TIVOLI-BROWNFIELD.**—This soil association consists of Tivoli and Brownfield fine sands. It is in an 8,000-acre area on the higher elevations in the northwestern part of the county. The soils are on nearly level and gently sloping plains and on strongly sloping subdued dunes (fig. 3).

The Tivoli soil is on the dunes and consists of loose sand that extends to a depth of many feet. This soil is very susceptible to wind erosion. The Brownfield soils are on the gently sloping to nearly level plains and are intermingled with the Tivoli soil.

All of this soil association is rangeland that has a thick stand of shin oak and sand sage and some tall grasses. When this cover is reduced or destroyed, the soil is highly susceptible to wind erosion. This association is not suited to cultivation, and most of it makes up parts of large ranches.

2. **SANDY SOILS: BROWNFIELD-AMARILLO.**—This soil association consists mainly of Brownfield, Amarillo, and Arvana soils. It makes up 28.1 percent of the county and is on the higher elevations, mostly in the western part. The soils are mainly fine sands and loamy fine sands that are gently sloping and nearly level to undulating.

The Brownfield soils are less extensive in the association than the Amarillo soils and more extensive than the Arvana soils. They have a light-colored, loose, sandy surface soil and a reddish sandy clay loam subsoil. The Amarillo soils are browner than the Brownfield soils and less sandy in the surface soil. The Arvana soils are of medium depth and occur with the Amarillo soils on ridges.

About 83 percent of this association is cultivated, and the rest is rangeland (fig. 4). Most of the cultivated area consists of Amarillo soils. The main crops are grain sorghum and cotton. About 34,000 acres, or one-fourth of the cultivated area, is irrigated by sprinklers, which are supplied water from wells that yield 400 to



Figure 4.—Native range in the Brownfield-Amarillo soil association can support a dense cover of mid grasses. About 67 percent of the vegetation on this range is little bluestem.

1,000 gallons per minute. The rangeland is in poor to fair condition. Its vegetation is mainly shin oak and includes some mid grasses.

3. **MIXED LAND: AMARILLO.**—This soil association consists mainly of Amarillo and Arvana fine sandy loams. It covers about 43 percent of the county. It is on the broad, nearly level to gently sloping plains. Almost all of it is in the central part of the county. The slopes are convex and generally not steeper than 3 percent. In this association are playas, or intermittent lakes, 3 to 5 acres in size.

About 96 percent of this association consists of Amarillo soils, which are very productive (fig. 5). Arvana soils occur along Sulphur Springs Draw. They are of medium depth.

About 87 percent of this association is cultivated, mainly to cotton and grain sorghum. About 26,000 acres, or about 12 percent of the cultivated area, is irrigated by sprinklers. Water from wells that yield 200 to 500 gallons per minute supplies these sprinklers. The average farm is about 335 acres.

4. **LIMY SOILS: PORTALES-ARCH.**—This soil association occurs in the north-central and southwestern parts of the county in low positions that generally have slopes less than 5 percent. It covers about 5 percent of the county.

This association consists mainly of Portales, Arch, and Drake soils. The Portales soils are the most extensive. They occur on nearly level plains and are closely associated with the Arch soils. They are darker than the Arch soils and contain less free lime. The Drake soils are on subdued dunes on the east side of playas.

Most of the acreage in this association is cultivated. Cotton and grain sorghum are the main crops.

5. **HARD LAND: AMARILLO-PORTALES.**—This soil association covers about 10 percent of the county and is adjacent to the caprock escarpment, mostly in the northeastern and southeastern parts.

Most of the association consists of Amarillo sandy clay loams, which are on nearly level and gently sloping broad plains. The Portales soils are in the more sloping areas associated with larger areas of Amarillo soils and are on flats below the Amarillo soils. Playas that range

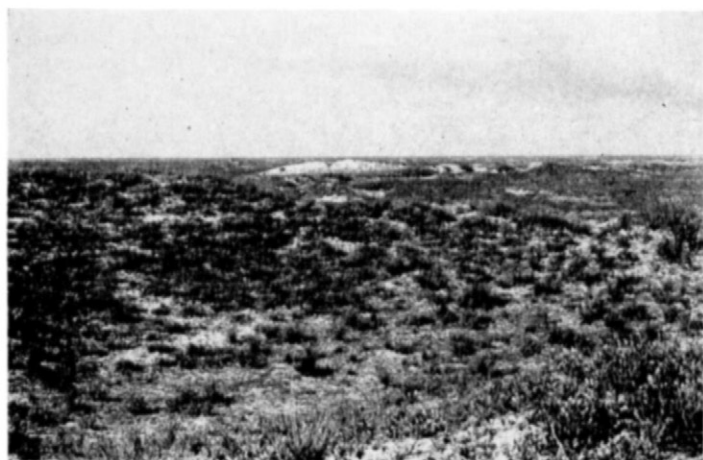


Figure 3.—Typical area in the Tivoli-Brownfield soil association. Sand dunes in the background indicate that the cover has been disturbed.



Figure 5.—Cropland in Amarillo soil association. Small lake in background has received water from an unprotected watershed.

from 40 to 180 acres in size dot the landscape. On the floors of these playas are clayey Randall soils.

Nearly all of this soil association is used for dryland farming. Very little water is available for irrigation. Cotton and grain sorghum are the main crops. The average-sized farm is about 310 acres.

Soil associations on the rolling plains

The soils on the rolling plains are mainly deep and heavy. They developed from Triassic Red Beds and from a thick mantle of outwash material that was deposited on these redbeds.

6. **SHALLOW OR STEEP SOILS: MANSKER-POTTER.**—This soil association covers about 8 percent of the county and is in three widely separated places. One is along the slopes of Sulphur Springs Draw, which extends from northwest to southeast across the county. Although this part of the soil association is far from the rolling-plains landscape, it is discussed with the rolling plains because it is similar to the area along the caprock escarpment. The area along the caprock escarpment makes up most of the Mansker-Potter soil association. The third area is in the north-central part of the county, and, like the area along Sulphur Springs Draw, is bordered by high plains.

This soil association consists mostly of Mansker and Potter soils. Along Sulphur Springs Draw, the Mansker soils are more extensive than the Potter soils. The Potter soils, however, make up a large part of the shallow or steep soils in the vicinity of the caprock escarpment. Also in this soil association are small areas of gently sloping Arvana and Kimbrough soils and areas of Stony rough land, Potter material. The soils in the area are shallow or steep, or are both shallow and steep.

About one-fifth of this area is cultivated, and the rest is rangeland.

7. **DEEP SOILS: BIPPUS-ABILENE.**—This soil association is on gentle slopes below the rough breaks in the caprock escarpment. It covers only about 18,000 acres, or about 3 percent of the county. It consists of Bippus, Miles, and Abilene soils.

The Bippus soils, which are the most extensive, are on foot slopes next to the Potter soils and Stony rough land, Potter material. The Miles soils are on the nearly level to gently sloping plains, and the Abilene soils are in the lower areas of the nearly level plains.

This soil association is used for range. Most of it makes up parts of large ranches that consist of 10,000 acres or more.

Effects of Wind Erosion

Any description of the soils of Dawson County would be incomplete unless the effects of wind erosion are discussed. Although the term, "eroded," does not appear in the soil names, all of the cultivated soils and some of the soils in range areas have been altered by the wind. On cultivated soils this alteration may include the removal of as much as one-half of the original A horizon, or surface soil; the removal of much of the organic matter, silt, and clay from the plow layer; or the accumulation of 4 to 6 inches of sandy material.

The finer textured soils—sandy clays and clay loams—apparently have been affected the least by wind erosion. This is because these soils usually can be roughened and clodded so that they resist the action of the wind. Nevertheless, the wind has removed much of the organic matter, silts, and clays from the sandy clay loams and clay loams, and the surface soil of these soils is coarser textured than it was before the soils were cultivated. These soils, therefore, are more susceptible to erosion, have less capacity for holding water and plant nutrients, and are more likely to form plow pans when tilled. Most cultivated areas that are mapped as fine sandy loams show the same effects as described for the sandy clay loams and clay loams.

Many areas that apparently were once fine sandy loams have been greatly altered by the wind. These areas are moderately susceptible to wind erosion. Some small areas have had nearly all of the original surface soil removed. In these areas, fertility has been reduced and the plant-soil-moisture-air relationship made poorer. Crop yields are lower than they were before erosion. Probably the most damaging effect of the wind on the fine sandy loams has been the removal of organic matter, silts, and clays from the plow layer. The sandy surface layer that remains is very infertile and is highly susceptible to wind erosion. To offset these effects, farmers have plowed deeper than usual so that the clayey material is brought up from below. Deep plowing has been repeated so many times in some areas that the upper 10 to 12 inches of the soil has had its texture changed from a fine sandy loam to a loamy fine sand.

In addition to the soils that have had the texture of their surface soil changed from fine sandy loam to loamy fine sand are many thousands of acres of loamy fine sand that have not had their texture changed. These loamy fine sands are not identified separately on the soil map from the loamy fine sands that were once fine sandy loams.

The loamy fine sands and fine sands are coarser textured than the loams and clays and show more drastic effects of wind erosion. In cultivated areas of these coarser textured soils, fence-row dunes as much as 10 feet high are common. Farm buildings are often nearly surrounded by loose sand dunes. County roads may be closed by the drifting sand in one strong blow. Farmers often have to plant three or four times because of the shifting sand of the blows early in spring. Abandoned fields may lose all of their thick sandy surface

soil (see fig. 7). Especially damaging is the infertile sand that is blown from these abandoned fields to adjoining areas of more productive soils.

Rangeland is also damaged by the wind, although to a lesser degree than is cultivated land. Several acres of rangeland may be covered with from 6 inches to 3 feet of sand that has been blown from adjoining sandy areas. This layer of sand smothers the desirable grasses and allows the growth of annual weeds and brush. Probably the least noticed yet most damaging effect of the wind is the result of the clays and silts being removed from cultivated land. These small particles are picked up by the wind and are carried many miles. Some of the particles are deposited in a thin mantle on much of the rangeland. This mantle is only $\frac{1}{8}$ to $\frac{1}{2}$ inch thick, but it forms a very effective crust that is almost impervious to water. Runoff and water erosion are increased, and desirable grasses lose moisture that is greatly needed.

Although the immediate effects of wind erosion are very apparent when they occur, it is difficult to positively identify and consistently map soil losses that are the result of soil blowing. On some kinds of soils, the winnowed surface layer can be erased by deep plowing and mixing with uneroded lower horizons. Low hummocks can be leveled. Blowout spots can be roughened, and nearby accumulations of surface soil can be loosened and allowed to drift over and accumulate in the blow-out areas.

Some areas in Dawson County have been so severely eroded that they are abandoned and are no longer cultivated. It appears evident that many other areas will eventually be eroded to the same extent as are the abandoned areas if accelerated wind erosion is not brought under control in the county.

Descriptions of Soils

This subsection is provided for those who want detailed information about the soils in the county. It describes the single soils, or mapping units; that is, the areas on the detailed soil map that are bounded by lines and identified by a symbol. For more general information about soils, the reader can refer to the subsection, General Soil Map, in which the broad patterns of soils in the county are described.

An important part of this subsection is the description of the soil series. A soil series is a group of soils that developed from similar parent material and, except for the texture of the surface soil, that have similar characteristics. The series description tells about the general nature of the soils in the series and their relation to the soils in other series. It also includes statements on topography, native vegetation, and use of the soils.

The descriptions of the single soils follow the series description. All the soils of one series that have the same texture in the surface soil are together. For example, all Amarillo soils that have a fine sandy loam surface soil are together, then the Amarillo soil with a loamy fine sand surface soil, and finally the Amarillo soils that have a sandy clay loam surface soil.

You can gain a working knowledge of a soil by reading that part of the soil description in normal print. If you want a detailed description of the soil, read the small print, which describes a representative profile and

variations from this profile. One representative profile in each type is described, and the other soils in the type, if any, are described by comparing them with this soil. A soil type is a group of soils that have similar profile characteristics including the texture of the surface soil, but may have other differences such as slope, erosion, or wetness.

In the profile description some terms are used that may not be familiar to the general reader. The upper layer, or surface soil, is the A horizon. This layer has had some of its clay and soluble mineral washed by water into the horizon below. The depth and thickness of each horizon are indicated by measurement from the surface of the soil downward.

The subsoil, or B horizon, contains clays and minerals that were washed from the A horizon. It is sometimes divided in B₁, B₂, or B₃ layers. In most places, the soil was formed from material similar to that which underlies the B horizon. This is called the C horizon. Many of the soils in Dawson County were formed from material containing free lime. In these soils lime has accumulated between the B and C horizons and a C_{ca} horizon has formed. Some soils do not have a B horizon, and the A horizon may be directly underlain by the C horizon or by a transitional A-C horizon.

In this report color is denoted both by a descriptive term for color of the dry soil, such as grayish brown, and by Munsell notations for both dry and moist soils, such as 10YR 5/2; 4/2, moist. The Munsell notations are precise symbols that denote hue, value, and chroma.

The texture of each horizon refers to the amount of sand, silt, and clay that make up the soil. Particles the size of sand (0.05 to 2.0 millimeters or 0.002 to 0.079 inch) make up more than 85 percent of a soil that has a fine sand texture. If you drove a car over fine sand, you would want the fine sand wet. A soil with clay texture contains enough fine material to make the soil sticky and plastic when it is wet. Sand particles never make up more than 45 percent of a clay, and clay particles (less than 0.002 millimeter or 0.000079 inch) always make up more than 35 percent. The size of a particle of silt (0.002 to 0.05 millimeter) is between that of sand and clay. Between the textures fine sand and clay are clay loam, fine sandy loam, and many other textures.

Structure refers to the arrangement of the soil grains into lumps, granules, or other natural aggregates. The distinctness, size, and shape of the aggregates are described by specific terms. Terms of distinctness are weak, moderate, and strong; terms of size are very fine, fine, medium coarse, and very coarse; and terms of shape are prismatic, blocky, subangular blocky, and granular. Soils without structure are described as structureless if they are sands or as massive if they are clays.

Consistence refers to the feel of the soil and can be described when soil is wet, moist, or dry. Common terms describing consistence are plastic when wet, friable when moist, and hard when dry.

Other characteristics of the soil horizons, such as the amount of pores, clay films, and insect activity, are also described. The presence of free lime is indicated by a statement about calcareousness.

Following the profile description are statements that tell how the soil varies from that described in the pro-

file description. If inclusions of other soils occur within a mapping unit, these are named.

Use and management are briefly described in the soil descriptions. At the end of each soil description are the names of the capability unit or units and the range site of the soil described. Some soils are in a different capability unit when they are irrigated than when they are dry-farmed. Others are in the same capability unit whether irrigated or dry-farmed. Discussions of the capability units and the range sites are in the section, Use and Management of Soils.

The location and distribution of the single soils are shown on the soil map at the back of this report. Their approximate acreage and proportionate extent are given in table 2.

TABLE 2.—Approximate acreage and proportionate extent of the soils

Soil	Area	Extent
	<i>Acre</i>	<i>Percent</i>
Abilene clay loam, 0 to 1 percent slopes.....	2, 621	0. 5
Amarillo fine sandy loam, 0 to 1 percent slopes.....	131, 900	22. 9
Amarillo fine sandy loam, 1 to 3 percent slopes.....	117, 990	20. 5
Amarillo loamy fine sand, 0 to 3 percent slopes.....	90, 558	15. 7
Amarillo sandy clay loam, 0 to 1 percent slopes.....	31, 062	5. 4
Amarillo sandy clay loam, 1 to 3 percent slopes.....	1, 034	. 2
Arch fine sandy loam, 0 to 1 percent slopes.....	2, 241	. 4
Arch loamy fine sand, 0 to 3 percent slopes, overblown.....	950	. 2
Arvana fine sandy loam, 1 to 3 percent slopes.....	2, 171	. 4
Arvana fine sandy loam, 0 to 1 percent slopes.....	1, 744	. 3
Arvana fine sandy loam, shallow, 0 to 3 percent slopes.....	5, 440	. 9
Arvana loamy fine sand, 0 to 3 percent slopes.....	737	. 1
Bippus clay loam, 1 to 3 percent slopes.....	8, 167	1. 4
Bippus clay loam, 0 to 1 percent slopes.....	914	. 2
Bippus clay loam, 3 to 5 percent slopes.....	4, 982	. 9
Brownfield fine sand, thin surface, 0 to 3 percent slopes.....	27, 339	4. 7
Brownfield fine sand, thick surface, 0 to 3 percent slopes.....	14, 134	2. 5
Brownfield fine sand, 0 to 3 percent slopes, eroded.....	5, 010	. 9
Drake fine sandy loam, 1 to 3 percent slopes.....	1, 332	. 2
Drake soils, 3 to 5 percent slopes.....	634	. 1
Kimbrough soils, 1 to 5 percent slopes.....	2, 786	. 5
Mansker fine sandy loam, 1 to 3 percent slopes.....	5, 957	1. 0
Mansker fine sandy loam, 0 to 1 percent slopes.....	947	. 2
Mansker fine sandy loam, 3 to 5 percent slopes.....	3, 687	. 6
Mansker clay loam, 0 to 1 percent slopes.....	2, 394	. 4
Mansker clay loam, 1 to 3 percent slopes.....	8, 502	1. 5
Mansker clay loam, 3 to 5 percent slopes.....	1, 461	. 2
Miles sandy clay loam, 1 to 3 percent slopes.....	999	. 2
Miles sandy clay loam, 0 to 1 percent slopes.....	531	. 1
Portales clay loam, 0 to 1 percent slopes.....	20, 993	3. 6
Portales clay loam, 1 to 3 percent slopes.....	3, 930	. 7
Portales fine sandy loam, 0 to 1 percent slopes.....	13, 215	2. 3
Portales fine sandy loam, 1 to 3 percent slopes.....	15, 498	2. 7
Potter soils, 8 to 30 percent slopes.....	13, 137	2. 3
Randall clay.....	7, 043	1. 2
Randall fine sandy loam, overblown.....	1, 197	. 2
Spur clay loam.....	3, 265	. 6
Spur fine sandy loam.....	2, 667	. 5
Stony rough land, Potter material.....	1, 612	. 3
Tivoli fine sand.....	7, 672	1. 3
Vernon soils, 1 to 8 percent slopes.....	2, 427	. 4
Vona loamy fine sand, 0 to 3 percent slopes.....	3, 888	. 7
Zita fine sandy loam, 0 to 1 percent slopes.....	592	. 1
Total.....	575, 360	100. 0

Abilene series

This series consists of deep, dark-colored, well-developed soils that are on low, nearly flat areas with concave slopes. The parent materials are water-laid deposits of soft, calcareous clay and clay loam.

Abilene soils are associated with Bippus and Miles soils. They are darker and less calcareous than the Bippus soils and are more strongly developed. They are less red than the Miles soils and contain more clay throughout the profile.

Only one Abilene soil is mapped in Dawson County. This soil is on the rolling plains and is used for range.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This soil has a dark-brown surface soil, 6 to 14 inches thick. Its subsoil is brown and more clayey than the surface soil. Below depths of 26 to 40 inches, the material is soft caliche that is lighter colored than the layers above.

Representative profile—

Location: 0.6 mile southwest and 0.15 mile north of stream and road crossing in northern part of section 32, block 1.

A₁ 0 to 8 inches, dark-brown (7.5YR 4/2; 3/2, moist) clay loam; weak, subangular blocky and granular structure; sticky when wet, friable when moist, and hard when dry; many fine roots throughout; noncalcareous; gradual boundary.

B₁ 8 to 14 inches, dark-brown (7.5YR 4/2; 3/2, moist) heavy clay loam; moderate, medium, subangular blocky structure; very sticky and plastic when wet, firm when moist, and very hard when dry; few, very fine, subrounded pebbles; many fine roots throughout; noncalcareous; clear boundary.

B₂ 14 to 24 inches, brown (7.5YR 5/3; 4/3, moist) heavy clay loam; moderate, medium, blocky structure; very sticky and plastic when wet, very firm when moist, and extremely hard when dry; about 25 percent overlap of peds; roots tend to follow ped faces; few hard fragments of calcium carbonate less than 3 millimeters in diameter; strongly calcareous; clear boundary.

B₃ 24 to 30 inches, brown (10YR 5/3; 4/3, moist) clay loam; very sticky and plastic when wet, firm when moist, and very hard when dry; some segregated calcium carbonate; few, very fine, subrounded pebbles; strongly calcareous; clear boundary.

C_{ca} 30 to 42 inches +, light-brown (7.5YR 6/4; 5/4, moist) clay loam; consistence same as in layer above; upper 6 inches contains much segregated calcium carbonate and a few hard concretions as much as 10 millimeters in diameter; violently effervescent in hydrochloric acid; clear boundary.

The A horizon is about 8 inches thick in most places but ranges from 6 to 14 inches in thickness. Most areas have a distinct B₁ horizon. It ranges from 4 to 12 inches in thickness but normally is about 6 inches thick. The thickness of the B₂ horizon ranges from 10 to 30 inches. Color ranges from dark brown in the A horizon to brown in the B horizon to light brown in the C_{ca} horizon.

Included with this soil are small areas of Bippus clay loam.

Use and management.—All of this soil is in range. If it is cultivated, it needs to be managed to conserve water because it tends to be droughty. Since it is only slightly susceptible to wind erosion or water erosion, it needs only moderate management to prevent erosion.

If dry-farmed, capability unit IIIec-1; if irrigated, capability unit IIe-1; range site: Deep hard land, rolling plains.

Amarillo series

In this series are deep, well-developed, moderately sandy, reddish soils. These soils occur on the high plains, where they developed from soft, calcareous, moderately

sandy parent material. They contain a layer of caliche below depths of 36 inches. The native vegetation consists of various grasses, shrubs, and forbs.

Amarillo soils are on smooth, nearly level flats and on convex, gentle slopes. They are associated with Arvana, Brownfield, Portales, and Zita soils. They occur below the Brownfield soils and slightly above the more nearly level Portales and Zita soils. The surface soil and subsoil of the Amarillo soils are similar to those of the Arvana soils, which are underlain by hard caliche at depths of less than 36 inches. Amarillo soils are less sandy and less red than the Brownfield soils, which do not have a horizon of calcium carbonate. They are less calcareous in the upper horizons than the Portales soils and are lighter colored than the Zita soils.

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).—This soil has a reddish-brown surface soil, 8 to 14 inches thick, and a reddish-brown to brown, sandy clay loam subsoil, 24 to 40 inches thick. The subsoil is underlain by soft, pink, caliche material at depths of 36 to 60 inches.

The vegetation on the range consists of much blue grama and side-oats grama and some buffalograss. Invading shrubs are catclaw and shrubby mesquite, but there is no shin oak.

Where this soil is associated with the Amarillo sandy clay loams, it occurs on the higher lying ridges and slopes. Where it is associated with Amarillo loamy fine sand, 0 to 3 percent slopes, it occurs on the smoother, lower lying flats and slopes. It is in large expanses that include the associated soils, small playas, and small amounts of shallow soils that developed over relict layers of hard caliche.

This soil was cultivated by the earliest settlers and has been in cultivation longer than many less desirable soils. Consequently, many areas have been eroded by wind to the extent that some of the clay and silt in the plow layer has been blown away and the upper 3 to 6 inches of surface soil is coarser than it used to be.

Representative profile—

Location: 0.1 mile north and 30 feet west of southeast corner of section 16, block 35, T. 5 N., T. and P. RR. survey. This is south of Lamesa, about 1½ miles east of the intersection of U.S. Highways 87 and 180.

A_{1p} 0 to 8 inches, reddish-brown (5YR 5/3; 4/3, moist) fine sandy loam; structureless; slightly sticky when wet, very friable when moist, slightly hard when dry; few fine roots; noncalcareous; abrupt boundary.

A₁₂ 8 to 14 inches, reddish-brown (5YR 4/3; 3/3, moist) fine sandy loam; weak, subangular blocky structure; consistence same as in A_{1p} horizon; few fine roots; many earthworm casts; noncalcareous; clear boundary.

B₂ 14 to 32 inches, reddish-brown (5YR 5/4; 4/4, moist) sandy clay loam; moderate, coarse, prismatic to weak, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; few fine roots; many tubes and pores; many earthworm casts; noncalcareous; clear boundary.

B₃ 32 to 44 inches, reddish-yellow (5YR 6/6; 5/6, moist) sandy clay loam; weak, subangular blocky structure; consistence same as in B₂ horizon; many tubes and pores; common films and threads of calcium carbonate; weakly calcareous; gradual boundary.

C_a 44 to 56 inches, pink (5YR 7/4; 6/4, moist) sandy clay loam; soft and hard concretions of calcium carbonate make up 20 percent of this layer; strongly calcareous; clear boundary.

C 56 to 60 inches +, same as horizon above but contains much less segregated calcium carbonate.

The A horizon ranges from 8 to 14 inches in thickness. In many places, the A_{1p}, or plow layer, is a very light fine sandy loam because the finer particles have been removed by the wind. The A horizon ranges from reddish brown (5YR 4/3; 3/3, moist) to dark brown (10YR 4/3; 3/3, moist).

The B₂ horizon ranges from 24 to 40 inches in thickness. It is reddish brown to brown. Hue ranges from 5YR to 7.5YR; value from 3 to 6, and chroma from 3 to 6. The lower part of the thicker B₂ horizon is higher in value and chroma than the upper part. In places the lower part of the B₂ horizon is calcareous.

The C_a horizon occurs at depths of 36 to 60 inches. It is pink (5YR 8/3; 7/3, moist) to pale brown (10YR 6/3; 5/3, moist). Soft and hard concretions of calcium carbonate, 5 to 20 millimeters across, make up 25 to 50 percent of this horizon.

Included with this soil are areas of Amarillo soil that have 3 to 6 inches of loamy fine sand in the plow layer. These areas have had a large part of their fine particles blown away. Also included are patches of the Portales fine sandy loams and the Arvana fine sandy loams that are less than 50 feet across. These patches are very susceptible to erosion.

Use and management.—This is the most productive soil in the county for dryland farming. If you dry-farm or irrigate, you can get good yields of cotton, grain sorghum, legumes, and grasses. Tests indicate that you cannot increase yields much by applying commercial fertilizer to dry-farmed soil. But nitrogen and phosphate applied to irrigated cotton, grain sorghum, and grasses will increase yields appreciably. The hazard of wind erosion is moderate. If adequate water is at hand, use sprinkler, level-border, or level-furrow irrigation.

If dry-farmed, capability unit IIIe-2; if irrigated, capability unit IIe-2; range site Mixed land, high plains.

Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).—This soil is on ridges within larger areas of Amarillo fine sandy loam, 0 to 1 percent slopes, and on the slopes along the borders of the many playas. It is slightly redder and has a thinner A horizon than Amarillo fine sandy loam, 0 to 1 percent slopes, and is shallower to the C_a horizon.

A typical area of this soil is 0.7 mile south of the northeast corner of section 7, block 3, D. L. Cunningham survey.

Use and management.—If you cultivate this soil, the hazard of sheet, gully, and wind erosion will be moderate. Because of the slope and the limited supply of water, sprinkler irrigation is used more often than any other kind.

If dry-farmed or irrigated, capability unit IIIe-3; range site: Mixed land, high plains.

Amarillo loamy fine sand, 0 to 3 percent slopes (AmB).—This is the sandiest Amarillo soil in the county. Slopes are long, convex, and, in most places, are not steeper than 2 percent. This soil has a reddish-brown to brown surface soil, 8 to 14 inches thick, and a red to brown, sandy clay loam subsoil, 18 to 40 inches thick. The subsoil is underlain by soft, pink caliche at a depth of about 4 feet.

The vegetation on the range is mainly blue grama, sand dropseed, and three-awn. There are also smaller amounts of other forbs and bunchgrass, a sparse stand of shin oak, and some bushy mesquite.

This soil is associated with the Brownfield fine sands where it occurs on the smoother, lower lying areas. Where it is associated with the Amarillo fine sandy loams, it occurs on the more rolling, higher lying areas.

Representative profile—

Location: 100 feet west and 50 feet south of northwest corner of section 88, block M., E. L. and R. RR. survey.

A_p 0 to 10 inches, brown (7.5YR 5/4; 4/4, moist) loamy fine sand; structureless; nonsticky when wet, nearly loose when moist, and soft when dry; few fine roots; noncalcareous; diffuse boundary.

B₂₁ 10 to 16 inches, brown (7.5YR 5/4; 4/4, moist) light sandy clay loam; weak, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; many fine roots; few tubes, pores, and earthworm casts; noncalcareous; clear boundary.

B₂₂ 16 to 46 inches, light reddish-brown (5YR 6/4; 5/4, moist) sandy clay loam; weak, prismatic and weak, subangular blocky structure; sticky when wet, firm when moist, and hard when dry; few fine roots, tubes, pores, and earthworm casts; texture is sandier in lower 5 inches; noncalcareous; clear boundary.

C_{ca} 46 to 54 inches +, pink (5YR 8/3; 7/3, moist) light sandy clay loam; sticky when wet and slightly hard when dry; few fine roots; strongly calcareous to very strongly calcareous.

The A horizon ranges from 10 to 14 inches in thickness. It is reddish brown to brown.

The B₂ horizon ranges from 14 to 42 inches in thickness. It is red to brown. Hue ranges from 2.5YR to 7.5YR, value from 3 to 6, and chroma from 4 to 8. Value and chroma are higher in the lower part of the thicker B₂ horizon. In places the lower part of the B₂ horizon is slightly calcareous at depths of 34 to 36 inches. The free lime is in the form of threads and films on the ped faces. In places a strongly calcareous B₃ horizon occurs above the C_{ca} horizon.

The C_{ca} horizon occurs at depths ranging from 30 to 64 inches. It is 6 to 20 inches thick. Its color is yellowish red (5YR 5/8; 4/8, moist) to pink (5YR 8/3; 7/3, moist). Soft and hard concretions of calcium carbonate, 5 to 25 millimeters across, make up 20 to 50 percent of this horizon.

The C horizon, or parent material, is pink to pinkish white fine sandy loam to clay loam that is friable, porous, and weakly to very strongly calcareous.

Included with this soil are small areas of Arvana loamy fine sand, 0 to 3 percent slopes, 3 to 5 acres in size.

Use and management.—This soil is productive, but it needs more intensive management than the Amarillo fine sandy loams, because it has a higher wind erosion hazard. The only practical way to irrigate is by sprinklers. Farmers have reported that they get good results from applying nitrogen and phosphate fertilizers to irrigated cropland.

If dry-farmed, capability unit IVE-3; if irrigated, capability unit IIIe-5; range site: Sandy land, high plains.

Amarillo sandy clay loam, 0 to 1 percent slopes (AnA).—This soil has a reddish-brown to dark-brown surface soil, 8 to 12 inches thick. Its subsoil is more clayey than the surface soil and contains a small amount of free lime in the lower part. The subsoil is underlain by soft, pink caliche at depths of 40 to 56 inches.

Buffalograss is the dominant vegetation on the range, and there is some blue grama. Brush does not invade this soil so much as it does the Amarillo fine sandy loams, but some areas do have scattered large mesquite trees.

This is an extensive soil that occurs in large areas. Locally it is called hard land or tight land. Most of it is along the eastern edge of the high-plains area where there are many playas, 60 or more acres in size. The floors of these playas consist of Randall soils, and the slopes consist of Amarillo sandy clay loam, 1 to 3 percent slopes.

Representative profile—

Location: 0.1 mile south and 0.2 mile east of junction of U.S. Highway 87 and Farm Road 1210, section 5, block 2, J. Poltevent survey.

A_p 0 to 8 inches, dark-brown (10YR 4/3; 3/3, moist) sandy clay loam; structureless; sticky when wet, friable when moist, and slightly hard when dry; noncalcareous; abrupt boundary.

B₂₁ 8 to 24 inches, dark-brown (7.5YR 4/2; 3/2, moist) clay loam; weak, coarse, prismatic and moderate, very fine, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; few worm cavities and insect burrows; if crushed, peds change in hue to 5YR; noncalcareous; clear boundary.

B₂₂ 24 to 30 inches, reddish-brown (5YR 4/4; 4/3, moist) clay loam; moderate, fine, prismatic structure; sticky when wet and friable when moist; many films and threads of calcium carbonate; some worm casts and pores; roots permeate the peds; weakly calcareous; clear boundary.

B₃ 30 to 42 inches, yellowish-red (5YR 5/6; 4/6, moist) clay loam; weak, prismatic and weak, subangular blocky structure; few concretions of calcium carbonate; strongly calcareous; abrupt boundary.

C_{ca} 42 to 56 inches, pink (7.5YR 7/4; 6/4, moist) clay loam; 30 percent of layer consists of calcium carbonate concretions; very strongly calcareous; abrupt boundary.

D₁ 56 inches +, hard caliche.

The A horizon ranges from 8 to 12 inches in thickness. The A_{1p} horizon is 6 to 8 inches thick and, in places, has had a large part of its fine particles blown away. In these places, the plow layer contains lenses of fine sandy loam and its texture is light sandy clay loam. In some areas there are inclusions that have a fine sandy loam surface layer, 3 to 4 inches thick. The A horizon is reddish brown (5YR 4/3; 3/3, moist) to dark brown (10YR 4/3; 3/3, moist). Hue ranges from 5YR to 10YR, value from 3.5 to 4.5 (mainly 4), and chroma from 2 to 4 (mainly 3).

The B₂ horizon is 10 to 24 inches thick. Its texture ranges from sandy clay loam to clay loam and its color from yellowish red (5YR 5/6; 4/6, moist) to brown (7.5YR 5/4; 4/4, moist). Hue is 5YR to 7.5YR, value 3 to 5 (mainly 5), and chroma 2 to 6 (mainly 4 to 6). Value and chroma are highest in the lower part of the thicker B₂ horizon. Roots are not so well distributed throughout the B₂ horizon as they are in Amarillo fine sandy loam, 1 to 3 percent slopes. The roots penetrate the peds in only a few places. The peds commonly have shiny clay films.

A weakly to strongly calcareous clay loam B₃ horizon, 6 to 12 inches thick, occurs at a depth of about 30 inches. It is red (5YR 5/6; 4/6, moist) to brown (7.5YR 5.5/2; 5/2, moist). Hue ranges from 5YR to 7.5YR, and chroma from 2 to 6 (mainly 6). The B₃ horizon has many threads and films of calcium carbonate. A few small areas of this soil have hard caliche rock at a depth of about 30 inches.

At 40 to 56 inches below the surface is a distinct, strongly calcareous to very strongly calcareous C_{ca} horizon. This horizon is a pink (7.5YR 7/4; 6/4, moist) to a pinkish white (5YR 8/2; 7/2, moist). Soft and hard concretions of calcium carbonate make up 20 to 40 percent of this horizon.

The C horizon, or parent material, is reddish yellow (5YR 6/6; 5/6, moist) to a white (10YR 3/2; 2/2, moist). This horizon is very strongly calcareous, friable, and fairly porous.

Included with this soil are some areas of Amarillo soils that have a fine sandy loam surface layer. The sandy texture is a result of the wind blowing away a large part of the fine particles. Also included are soils that are similar to the Portales soils; these inclusions are normally less than 200 feet across. There are also some slightly depressed, nearly level soils that are transitional to the Portales and Zita soils as well as some shallow areas of Mansker clay loam.

Use and management.—This soil is very productive if rainfall is adequate. In years that rainfall is higher than normal, you can expect good yields of cotton, grain sorghum, grasses, and legumes. If rainfall is less than normal, however, yields are lower than those on Amarillo fine sandy loam, 0 to 1 percent slopes. If you cultivate this soil the wind-erosion hazard will be slight

to moderate and the water-erosion hazard slight. Conserve all water possible. Under irrigation, this is the most productive soil in the county, but very little water is available for irrigation.

If dry-farmed, capability unit IIIec-1; if irrigated, capability unit IIe-1; range site: Deep hard land, high plains.

Amarillo sandy clay loam, 1 to 3 percent slopes (AnB).—This soil is on very gently sloping areas next to the large playas. The slopes exceed 2 percent in only a few places. Tracts of this soil generally are less than 100 acres, and they always occur with much larger areas of Amarillo sandy clay loam, 0 to 1 percent slopes. The C_{ca} horizon is slightly shallower than the C_{ca} horizon of Amarillo sandy clay loam, 0 to 1 percent slopes.

A representative area of this soil is located 200 feet north and 100 feet west of the southeast corner of section 1, block 1, J. Poitevent survey.

Use and management.—You will have a moderate hazard of both wind and water erosion if you cultivate this soil. The most effective way to irrigate is by the level-border system. Because of the scarcity of water, very little of this soil is irrigated.

If dry-farmed or irrigated, capability unit IIIe-1; range site: Deep hard land, high plains.

Arch series

In this series are shallow, light-gray, strongly calcareous soils that are on the large flats or benches of ancient playas or are in large depressions. These soils are underlain by chalky material consisting of old alluvium that has been modified by calcic carbonate. The calcium carbonate was deposited by ground water or by runoff from higher areas.

Arch soils are associated with the Drake, Mansker, and Portales soils. They are similar to the Drake soils, which are on the eastern side of playas on hills and dunes formed by the wind. They are lighter colored than the Mansker soils and are lighter colored, more calcareous, and shallower than the Portales soils.

Arch soils have a small total acreage, much of which is used for cotton and sorghum.

Arch fine sandy loam, 0 to 1 percent slopes (ArA).—This soil has a light-gray, strongly calcareous surface soil, 6 to 10 inches thick. The subsoil is sandy clay loam that is lighter gray than the surface soil. It is underlain at depths of 16 to 26 inches by white, very strongly calcareous, soft caliche. This soil is on large benches above the playas or is in wide, slightly depressed areas that appear to be ancient lake beds.

Representative profile—

Location: 0.35 mile south and 100 feet west of the northeast corner of section 6, block H., E. L. and R. RR. survey.

A_p 0 to 10 inches, light-gray (10YR 7/2; 4/2, moist) fine sandy loam; structureless; slightly sticky when wet, friable when moist, and slightly hard when dry; many fine roots; few soft concretions; contains about 2 inches of material from horizon below, which is well mixed with material of this horizon; strongly calcareous; abrupt boundary.

AC 10 to 16 inches, light-gray (10YR 7/2; 4/2, moist) sandy clay loam; weak prismatic and weak subangular blocky structure; sticky when wet, firm when moist, and slightly hard when dry; many fine roots; few tubes and pores; many earthworm casts; few soft concretions of calcium

carbonate as much as 5 millimeters in diameter; very strongly calcareous; clear boundary.

C_{ca} 16 to 26 inches, white (10YR 8/2; 7/2, moist) clay loam; weak, subangular blocky structure; very sticky when wet, firm when moist, and hard when dry; few fine roots; few tubes and pores; many earthworm casts; very strongly calcareous; diffuse boundary.

C 26 to 60 inches +, white (10YR 8/2; 7/2, moist) light sandy clay loam that is sandier with increasing depth; very strongly calcareous.

The A horizon ranges from 6 to 10 inches in thickness. Its hue is 10YR, value is 4 to 7, and chroma is 2 to 3.

The AC horizon ranges from 6 to 15 inches in thickness and from sandy clay loam to clay loam in texture. Hue is 10YR, value is 5 to 7, and chroma is 2.

The C_{ca} horizon occurs at depths ranging from 16 to 25 inches. Its texture ranges from sandy clay loam to clay loam. Hue is 10YR to 2.5Y, value is 6 to 8, and chroma is 1 to 3.

Included with this soil are small areas that have slopes of 1 to 1½ percent. These areas are on narrow ridges and on short slopes into small depressions. Also included are small areas that resemble areas of Portales soils.

Use and management.—If you irrigate this calcareous soil, it will produce good yields of cotton. But sorghum is susceptible to chlorosis, or the yellowing of leaves. Use a vegetative cover in cultivated areas to prevent wind erosion. Because this soil contains much lime, the clods formed by tilling are not stable. They break down readily, and much of the soil material is blown away. You can use level-border, level-furrow, or sprinkler irrigation on this soil.

If dry-farmed, capability unit IVe-1; if irrigated, capability unit IIIe-4; range site: High lime, high plains.

Arch loamy fine sand, 0 to 3 percent slopes, overblown (AsB).—This soil occurs in low areas in association with Amarillo, Brownfield, Vona, and other Arch soils. Its surface soil consists of material that has been blown or washed from these associated soils. It is brown, noncalcareous loamy fine sand, 14 to 22 inches thick. The subsoil is brown sandy clay loam that extends to depths of 20 to 42 inches and is underlain by white, strongly calcareous, soft caliche.

Representative profile—

Location: In cultivated field 0.3 mile north and 50 feet east of southwest corner of section 3, block H., E. L. & R. RR. survey.

A_p 0 to 20 inches, brown (7.5YR 5/4; 4/4, moist) loamy fine sand; structureless; nonsticky when wet, very friable when moist, and nearly loose when dry; many fine roots; about 2 to 3 inches of horizon below has been plowed into this horizon and is mostly in clods about 3 inches in diameter; noncalcareous; abrupt boundary.

A_{1b} 20 to 28 inches, dark-brown (7.5YR 4/4; 3/4, moist) sandy clay loam; moderate, fine, subangular blocky structure; sticky when wet, very firm when moist, and hard when dry; many roots and tubes; pores as much as 5 millimeters in diameter; noncalcareous; abrupt boundary.

C_{ca} 28 to 38 inches, white (10YR 8/2; 7/2, moist) sandy clay loam; weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; strongly calcareous; clear boundary.

C_{1b} 38 to 46 inches, very pale brown (10YR 8/3; 7/3, moist) fine sandy loam; weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; strongly calcareous; clear boundary.

C_{2b} 46 to 60 inches, light-brown (7.5YR 6/4; 5/4, moist) sandy clay loam; moderate, fine, subangular blocky structure; sticky when wet, very firm when moist, and hard when dry; many semihard concretions of calcium carbonate as much as 10 millimeters in diameter; segregated calcium carbonate in lower 6 inches.

The A_p horizon ranges from 14 to 26 inches in thickness. It is yellowish brown (10YR 5/4; 4/4, moist) to light brown (7.5YR 6/4; 5/4, moist). The A_{1b} horizon ranges from 6 to 15 inches in thickness but is generally less than 12 inches thick and in some places is absent.

The depth to the C_{ca} horizon ranges from 26 to 50 inches. It is white (10YR 8/2; 7/2, moist) to pink (7.5YR 8/4; 7/4, moist).

Use and management.—If it is irrigated, this sandy soil produces fair yields of cotton. Cultivated areas, however, must be managed against wind erosion. The clods on tilled soil do not offer much protection because they contain much lime and are unstable. Use a vegetative cover to prevent wind erosion. This soil can be irrigated by sprinklers.

If dry-farmed, capability unit IVE-3; if irrigated, capability unit IIIe-5; range site: Sandy land, high plains.

Arvana series

In this series are well-developed, reddish, sandy soils that are underlain by hard, platy caliche at depths ranging from 10 to 36 inches. These soils developed on a thin mantle of sandy material that was deposited by the wind on the hard caliche. The top of the caliche is smooth and rounded, but the bottom is concretionary or knobby. The present vegetation is mainly grama and buffalograss but includes some dropseed, *Andropogons*, and a thin growth of yucca, catclaw, and small mesquite shrubs.

These soils are associated with Amarillo and Kimbrough soils. Arvana soils occur with Amarillo soils along ridgetops and in areas where the Amarillo soils change elevation. They are shallower than Amarillo soils, which are underlain by unconsolidated parent material. They are deeper than Kimbrough soils and, in many places, surround small areas of Kimbrough soils on gradual slopes below ridgetops.

Arvana soils are used mainly for grazing livestock, particularly beef cattle. Some of the deeper soils are used for cotton, grain sorghum, and other crops. Many small, shallow areas are idle.

Arvana fine sandy loam, 1 to 3 percent slopes (AvB).—This soil has a dark-brown to reddish-brown surface soil, 6 to 10 inches thick. Its subsoil is red to reddish-brown sandy clay loam, 10 to 30 inches thick. Hard, platy caliche underlies the subsoil. This soil generally occurs on gentle, convex slopes. In most places it occurs with Amarillo soils where the Amarillo soils change elevation. Areas of this soil that have been cultivated for a long time, or have been shifted about by the wind, have been damaged by wind erosion to the extent that much of the clay and silt has blown away. The plow layer is now a coarser texture than it used to be.

Representative profile—

Location: 5 miles west of the junction of U.S. Highway 180 and State Highway 137, then 1 mile north and 0.25 mile east.

A_p 0 to 6 inches, dark-brown (7.5YR 4/4; 3/4, moist) fine sandy loam; structureless; nonsticky when wet, friable when moist, and soft when dry; noncalcareous; common, fine roots; few tubes and pores as much as 2 millimeters in diameter; abrupt boundary.

B_{21} 6 to 14 inches, reddish-brown (5YR 4/3; 3/3, moist) light sandy clay loam; weak, prismatic and weak, subangular blocky structure; sticky when wet, firm when moist, and slightly hard when dry; many fine roots; common tubes and pores as much as 3 millimeters in

diameter; some worm casts; noncalcareous; gradual boundary.

B_{22} 14 to 26 inches, yellowish-red (5YR 4/8; 3/8, moist) heavy sandy clay loam; moderate, fine, subangular blocky structure; sticky when wet, firm when moist, and hard when dry; many fine roots; many tubes and pores as much as 3 millimeters in diameter; many earthworm casts and insect burrows; noncalcareous; diffuse boundary.

B_3 26 to 34 inches, reddish-yellow (5YR 6/8; 5/8, moist) sandy clay loam; structure and consistence same as in layer above; many fine roots; few tubes and pores as much as 2 millimeters in diameter; few earthworm casts and insect burrows; slightly calcareous.

D_{ca} 34 inches +, hard, rocklike caliche.

The A_p horizon ranges from 6 to 10 inches in thickness. Hue is 5YR to 7.5YR, value is 4 to 5, and chroma is 2 to 6.

The B_{21} horizon ranges from 8 to 18 inches in thickness. Hue is 2.5YR to 7.5YR, value is 3 to 5, and chroma is 2 to 6.

The B_{22} horizon ranges from 4 to 12 inches in thickness. Structure is moderate, fine, subangular blocky to moderate, medium, subangular blocky. Hue ranges from 2.5YR to 5YR, value from 3 to 5, and chroma from 4 to 8. The depth to the hard caliche ranges from 20 to 36 inches.

Included with this soil are small areas of Amarillo fine sandy loam, 0 to 1 percent slopes. Also included are areas, normally less than 50 feet across, that resemble the Portales soils and make up less than 10 percent of this mapping unit.

Use and management.—Although this soil is productive, its water-holding capacity and, therefore, its uses are limited. There is enough moisture, however, for dry farming. If you irrigate, the shallow depth limits the amount of water that can be applied without waste. Irrigated cotton, grain sorghum, and grasses have benefited from application of nitrogen and phosphate. If you cultivate this soil, it will be susceptible to moderate wind and water erosion.

If dry-farmed or irrigated, capability unit IIIe-3; range site: Mixed land, high plains.

Arvana fine sandy loam, 0 to 1 percent slopes (AvA).—This soil is slightly less red than Arvana fine sandy loam, 1 to 3 percent slopes, and, in some places, has a thicker A_1 horizon.

A representative area of this soil is 0.15 mile south and 0.4 mile west of northeast corner section 37, 35 T. 6 N., T. and P. RR. survey.

Use and management.—If you cultivate this soil, it will be susceptible to moderate wind erosion and slight water erosion.

If dry-farmed, capability unit IIIe-2; if irrigated, capability unit IIe-2; range site: Mixed land, high plains.

Arvana fine sandy loam, shallow, 0 to 3 percent slopes (AvB).—This soil differs from Arvana fine sandy loam, 1 to 3 percent slopes, in that it is underlain by the hard caliche at depths ranging from 10 to 20 inches (fig. 6). Cultivated areas have hard fragments of caliche scattered throughout the plow layer. Most of this soil is gently sloping but some is nearly level.

A representative area is 0.15 mile west and 400 feet north of the southeast corner of the northeast quarter of section 11, block 34. H. E. and W. T. RR. survey.

Use and management.—Use is limited by the shallow depth of this soil and the consequent low available water-holding capacity. The water available to plants is also reduced by runoff and by the water passing through cracks in the caliche. If you cultivate this soil, you will find it moderately susceptible to both wind and water erosion.



Figure 6.—Profile of Arvana fine sandy loam, shallow, 0 to 3 percent slopes, showing A, B, and D horizons. The D horizon is the hard, platy caliche.

If dry-farmed, capability unit IVE-4; if irrigated, capability unit IIIe-6; range site: Mixed land, high plains.

Arvana loamy fine sand, 0 to 3 percent slopes (AyB).—This soil has a light-colored surface soil, 10 to 16 inches thick. Its subsoil—a red to reddish-brown sandy clay loam—is underlain by hard, platy caliche at depths ranging from 20 to 36 inches. Most of this soil is in the western third of the county.

The native vegetation consists of shin oak, scattered bushy mesquite, little bluestem, sand dropseed, and other mid grasses.

Many areas of this soil originally had a fine sandy loam surface soil. Long periods of cultivation and inadequate protection have resulted in the clay and silt being blown out of the plow layer. This has changed the surface texture to a loamy fine sand.

Representative profile—

Location: 0.75 mile east and 0.15 mile north of the southwest corner of section 16, block C-39, Public school land.

A_p 0 to 12 inches, yellowish-red (5YR 5/6; 4/6, moist) loamy fine sand; structureless; nonsticky when wet, very

friable when moist, and nearly loose when dry; many fine roots; noncalcareous; abrupt boundary.

A₃ 12 to 18 inches, dark-brown (7.5YR 4/2; 3/2, moist) fine sandy loam; weak, prismatic structure; slightly sticky when wet, friable when moist, and slightly hard when dry; many fine roots; noncalcareous; gradual boundary.

B₂ 18 to 34 inches, reddish-brown (5YR 4/4; 3/4, moist) sandy clay loam; moderate, coarse, prismatic and weak, subangular blocky structure; sticky when wet, firm when moist, and hard when dry; many fine roots; many fine tubes and pores; few earthworm casts; faint clay films on prism faces; noncalcareous; abrupt boundary.

D₁ 34 inches +, hard, platy caliche.

The A_p horizon ranges from 10 to 14 inches in thickness. Hue ranges from 5YR to 7.5YR, value from 4 to 5, and chroma from 4 to 6. The A₃ horizon, which may or may not occur, ranges from 4 to 6 inches in thickness.

The B₂ horizon ranges from 10 to 26 inches in thickness. Hue is normally 5YR, value ranges from 4 to 5, and chroma from 4 to 6.

The depth to hard, platy caliche ranges from 20 to 36 inches.

Included with this soil are small areas of Amarillo loamy fine sand, 0 to 3 percent slopes, and Brownfield fine sand, thin surface, 0 to 3 percent slopes.

Use and management.—Although this soil is productive, it needs more exacting management than the Arvana fine sandy loams to prevent erosion. If you dry-farm, you can control wind erosion by planting, in closely spaced rows, crops that leave a large amount of residue.

Sprinkler irrigation is the only practical method of irrigating this soil. Farmers have reported good results from the use of nitrogen and phosphate fertilizers on irrigated areas.

If dry-farmed, capability unit IVE-3; if irrigated, capability unit IIIe-5; range site: Sandy land, high plains.

Bippus series

In this series are dark-colored, deep soils that have a moderately permeable subsoil. The parent material is strongly calcareous alluvium that was washed from nearby slopes underlain by calcareous outwash. The Bippus soils are mostly on the rolling plains, but some areas are on the sides of deep drains that have cut into the high plains. Most of the acreage is on foot slopes below steeply sloping Potter soils that are on the caprock escarpment.

Bippus soils are associated with Abilene and Miles soils. They are more calcareous and less clayey than the Abilene soils and are on higher, more sloping areas. They are less red than the Miles soils and less well developed.

All of the acreage in Bippus soils—about 14,000 acres—is used for range.

Bippus clay loam, 1 to 3 percent slopes (BcB).—This soil has a brownish slightly calcareous surface soil, 8 to 12 inches thick. Its subsoil is lighter colored and more calcareous than the surface soil. In some places pink to light-brown caliche occurs at depths ranging from 26 to 40 inches.

Representative profile—

Location: 0.5 mile south of the northeast corner of section 28, block 33, T. 5 N., T. and P. RR. survey.

A₁ 0 to 10 inches, dark-brown (10YR 4/3; 3/3, moist) clay loam; weak, subangular blocky and granular structure; sticky when wet, friable when moist, and slightly hard

when dry; many fine roots; few insect burrows and worm casts; few calcium carbonate concretions as much as 5 millimeters in diameter; many fine tubes and pores; slightly calcareous; clear boundary.

- AC 10 to 30 inches, brown (7.5YR 5/4; 4/4, moist) clay loam; weak, prismatic structure and moderate, medium, subangular blocky and granular structure; sticky when wet, firm when moist, and hard when dry; few fine roots; common worm casts and insect burrows as much as 5 millimeters in diameter; few calcium carbonate concretions as much as 5 millimeters in diameter; strongly calcareous; gradual boundary.

- C 30 to 60 inches +, pink (7.5YR 7/4; 6/4, moist) clay loam; few fine calcium carbonate concretions as much as 2 millimeters in diameter; very strongly calcareous.

The A horizon ranges from 8 to 12 inches in thickness. It is dark brown to light brown. The lighter colored areas of this soil generally are more sloping than the darker areas and are nearer the steeper Potter soils or Stony rough land, Potter material. These lighter soils are normally more sandy than the darker soils.

The AC horizon ranges from 10 to 20 inches in thickness and is brown to light-brown clay loam.

Use and management.—All of this soil is used for range. If it were cultivated, it would be susceptible to slight wind erosion and moderate water erosion.

If dry-farmed or irrigated, capability unit IIIe-1; range site: Hard land slopes, rolling plains.

Bippus clay loam, 0 to 1 percent slopes (BcA).—This soil is slightly darker than Bippus clay loam, 1 to 3 percent slopes, and is less calcareous throughout the profile. It is associated with that soil on level or nearly level areas, some of which are concave.

A representative area of this soil is 1 mile south of U.S. Highway 180 in the northeast corner of section 28, block 33, T. 5 N.

Use and management.—All of this soil is in range. If it were cultivated, it would be susceptible to slight wind and water erosion.

If dry-farmed, capability unit IIIec-1; if irrigated, capability unit IIe-1; range site: Hard land slopes, rolling plains.

Bippus clay loam, 3 to 5 percent slopes (BcC).—This soil shows little profile development. Its characteristics vary a great deal from place to place. This soil is on the rolling plains on the steeper foot slopes below the Potter soils and on the sides of deep drains that have cut into the high-plains area.

A representative area of this soil is 0.3 mile east and 0.2 mile north of the southwest corner of section 18, block 33, T. 4 N.

Use and management.—All of this soil is in range and probably should be kept in range. If it were cultivated, it would be highly susceptible to water erosion, especially gullying.

If dry-farmed or irrigated, capability unit IVe-2; range site: Hard land slopes, rolling plains.

Brownfield series

This series consists of loose, sandy soils that occur mostly in the western third of the county. These soils have a reddish, friable sandy clay loam subsoil. They do not have distinct calcium carbonate horizons, but in some places, they are underlain by hard or soft caliche. This underlying caliche is thought to be a relict carbonate layer upon which windblown material was deposited. The parent materials are reddish or reddish-yellow light sandy clay loam to loamy fine sand. The vegetation

consists almost entirely of grasses, shrubs, and annuals that generally grow on semiarid, sandy soils in the area. It includes tall and mid bunchgrasses, shin oak, sand sage, and some bushy mesquite.

The Brownfield soils that are cultivated are highly susceptible to wind erosion. If these soils are not well managed and adequately protected by crop residue, the soil in the plow layer is continually shifted by the wind. Small amounts of silt and clay are blown away, and the soil is sandier and less fertile than before. Its moisture-holding capacity is reduced and crop yields are lessened. Fence-row dunes, as much as 10 feet high, are common.

Brownfield soils are associated with the Amarillo and Tivoli soils. They occur on gently rolling slopes above smoother Amarillo soils and below dunelike Tivoli soils. They have a thicker, lighter colored surface soil than the Amarillo soils, which have horizons of carbonate accumulation. Their subsoil is redder than that of the Amarillo soils and has much less biological activity. Brownfield soils were developed from much sandier parent material than were Amarillo soils. They have a better developed subsoil than the Tivoli soils.

Brownfield soils make up slightly less than 10 percent of the county. They are used mostly for range.

Brownfield fine sand, thin surface, 0 to 3 percent slopes (BnB).—This soil has a brown to yellowish-red surface soil, 10 to 18 inches thick. The subsoil is a yellowish-red to red sandy clay loam, which is underlain by a lighter colored light sandy clay loam. Large expanses of this soil are on the high, well-drained areas and, in some places, surround smaller areas of sandy Amarillo soils.

Representative profile—

Location: From junction of U.S. Highway 180 and State Highway 137, 11 miles west on U.S. Highway 180 and then 200 feet north in pasture.

- A₁ 0 to 14 inches, brown (7.5YR 5/4; 4/4, moist) fine sand; structureless; nonsticky when wet, very friable when moist, and loose when dry; many fine roots; few tubes and pores as much as 3 millimeters in diameter; noncalcareous; abrupt boundary.

- B₂₁ 14 to 34 inches, yellowish-red (5YR 5/6; 4/6, moist) sandy clay loam; moderate, coarse, prismatic and moderate, fine, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; few fine roots; many small tubes and pores as much as 1 millimeter in diameter; few earthworm casts; noncalcareous; gradual boundary.

- B₂₂ 34 to 54 inches, red (2.5YR 4/6; 3/6, moist) sandy clay loam that is lighter in color with increasing depth; sticky when wet, friable when moist, and very hard when dry; very fine roots; few fine tubes and pores less than 1 millimeter in diameter; few worm casts; noncalcareous; gradual boundary.

- C 54 to 72 inches, yellowish-red (5YR 5/8; 4/8, moist) light sandy clay loam; sticky when wet, friable when moist, and hard when dry; very few fine roots; many fine tubes and pores less than 1 millimeter in diameter; few worm casts; noncalcareous.

The A₁ horizon ranges from 10 to 18 inches in thickness and from brown to yellowish red in color.

The B horizon ranges from reddish brown to yellowish red, but, in most places, it is red or yellowish red.

The C horizon ranges from light sandy clay loam to loamy fine sand and is normally noncalcareous. It is yellowish red to reddish yellow.

Included with this soil are small areas that have slopes of 3 to 5 percent and small areas of Brownfield fine sand, thick surface, 0 to 3 percent slopes; Amarillo loamy fine sand, 0 to 3 percent slopes; and Arvana loamy fine sand, 0 to 3

percent slopes. Also included are areas of Brownfield soil that have a loamy fine sand surface soil. These areas have been plowed deeply, and some of the clayey material in the subsoil has been mixed with the surface soil.

Use and management.—This soil is used mostly for range, but some of it is cultivated, mainly to cotton and grain sorghum. Cultivated areas are very susceptible to wind erosion. For several years, farmers have deep plowed this soil and mixed the sandy clay loam in the subsoil with the fine sand in the surface soil. This practice, along with other good management, helps to reduce or control wind erosion. Use only sprinkler irrigation in areas that can be feasibly irrigated.

If dry-farmed, capability unit IVE-3; if irrigated, capability unit IIIe-5; range site: Sandy land, high plains.

Brownfield fine sand, thick surface, 0 to 3 percent slopes (BkB).—This soil is sandier throughout the profile than Brownfield fine sand, thin surface, 0 to 3 percent slopes, and is more susceptible to wind erosion. Its surface soil ranges from 20 to 30 inches in thickness. In the landscape, which is generally undulating to rolling, are small depressions, 6 to 12 inches or more deep, and subdued mounds, 1 foot or more high and 3 to 5 feet in diameter.

Representative profile—

Location: 100 feet west and 100 feet north of southeast corner of labor 74, league 279, Hutchinson County school land.

- A₁ 0 to 28 inches, brown (7.5YR 5/4; 4/4, moist) fine sand; structureless; nonsticky when wet, very friable when moist, and loose when dry; few fine roots; noncalcareous; abrupt boundary.
- B₂ 28 to 58 inches, red (2.5YR 4/6; 3/6, moist) sandy clay loam; moderate, coarse, prismatic and weak, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; few fine roots; few small tubes and pores; faint clay films; noncalcareous; clear boundary.
- B₃ 58 to 72 inches +, yellowish-red (5YR 5/8; 4/8, moist) fine sandy loam; weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; few worm casts; noncalcareous; sandier in lower few inches.

The A horizon is 28 to 30 inches thick in most places, but thickness ranges from 18 to 48 inches. This horizon is pale brown to reddish brown.

The B horizon ranges from 10 to 36 or more inches in thickness but, in most places, is between 20 and 30 inches thick. Texture is sandy clay loam. Color varies from red to yellowish red.

The C horizon, in many places, is too deep to be reached with an auger. Texture ranges from a light sandy clay loam to a loamy fine sand. Color is very pale brown to reddish yellow.

Included with this soil are a few small areas that have slopes greater than 5 percent. Also included are small areas of Brownfield fine sand, thin surface, Amarillo loamy fine sand, and Arvana loamy fine sand.

Use and management.—Deep plowing is impractical because, in most places the deep sand is so thick that the clayey subsoil cannot be brought up to mix with the surface soil. To prevent wind erosion, keep this soil covered by protective vegetation.

If dry-farmed, capability unit VIe-2; if irrigated, capability unit IVE-6; range site: Sandy land, high plains.

Brownfield fine sand, 0 to 3 percent slopes, eroded (BfB3).—Wind erosion and deposition are more severe on this soil than they are on Brownfield fine sand, thick

surface, 0 to 3 percent slopes. In most places more than half of the original surface soil has been blown away, and in some places all of it is gone. In places there are small blowouts as much as 3 feet deep and dunes as much as 3 feet high. Some areas of this soil have been abandoned for several years. The blowouts in these abandoned areas have moderately good stands of sand dropseed, three-awn, silver bluestem, and some snake broomweed, and the dunes have some shin oak.

A representative area of this soil is located in the southwest quarter of section 85, block M., E. L. and R. RR. survey.

Use and management.—Farmers have found that it is not economical to reclaim this soil for cultivation.

If dry-farmed, capability unit VIe-2; if irrigated, capability unit IVE-6; range site: Sandy land, high plains.

Drake series

In this series are light-colored, weakly developed, strongly calcareous soils that make up stabilized dunes at the eastern side of playas. These soils consist of materials that have been blown fairly recently from strongly calcareous soils on the dry playa beds. Most of the acreage in Drake soils has slopes more than 2 percent, and some small areas have slopes as steep as 8 percent.

These soils are associated with Arch and Portales soils, which are more nearly level than the Drake soils. They are lighter colored than the Portales soils and more strongly calcareous.

Drake soils have a small total acreage in Dawson County. Some of the less sloping areas are in crops. The steeper areas are in range.

Drake fine sandy loam, 1 to 3 percent slopes (DfB).—This soil has light brownish-gray to pale-brown surface soil, 6 to 8 inches thick. The subsoil is fine sandy loam to sandy clay loam that is lighter colored than the surface soil. This soil is strongly calcareous to depths of many feet and is susceptible to erosion.

Most areas of this soil range from 5 to 25 acres in size and are surrounded by large areas of Amarillo soils. Some large areas are associated with large, level areas of Arch soils in the north-central part of the county near the Lynn County line. A few areas are on the eastern slopes of shallow drainageways in the northwestern part of Dawson County.

Representative profile—

Location: Northwest corner of section 3, block C-41, Public school land.

- A_p 0 to 8 inches, pale-brown (10YR 6/3; 5/3, moist) fine sandy loam; structureless; slightly sticky when wet, friable when moist, and slightly hard when dry; many fine roots; few tubes and pores; 2 or 3 inches of material in horizon below is well mixed into this horizon; few clods of the mixed material are on the surface; strongly calcareous; abrupt boundary.
- AC 8 to 20 inches, very pale brown (10YR 7/3; 6/3, moist) sandy clay loam; weak, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; many fine roots; few tubes and pores; strongly calcareous; clear boundary.
- C_{ea} 20 to 36 inches, very pale brown (10YR 8/3, moist) clay loam; very sticky when wet, firm when moist, and hard when dry; many fine roots; few tubes and pores; some partly segregated calcium carbonate; very strongly calcareous; diffuse boundary.

C 36 to 60 inches +, color same as C_{ca} horizon; sandy clay loam; sticky when wet, firm when moist, and hard when dry; few fine roots; few tubes and pores; few soft concretions; very strongly calcareous.

The A_p horizon ranges from 6 to 8 inches in thickness.

Hue is 10YR, value is 5 to 6, and chroma is 2 to 3.

The AC horizon ranges from 12 to 24 inches in thickness.

Its texture is fine sandy loam to sandy clay loam. Hue is 10YR, value is 6 to 7, and chroma is 2 to 3.

The C_{ca} horizon ranges from sandy clay loam to clay loam in texture. Hue is 2.5Y to 10YR, value is 8, and chroma is 2 to 4.

Included with this soil are small areas having slopes that exceed 3 percent.

Use and management.—If this soil is cultivated, it is susceptible to severe wind erosion and moderate water erosion. Use is also restricted by a low available water-holding capacity and a high content of lime. The lime tends to prevent plants from obtaining the plant nutrients they need.

If dry-farmed, capability unit IVe-1; if irrigated, capability unit IIIe-4; range site: High lime, high plains.

Drake soils, 3 to 5 percent slopes (DrC).—These soils are steeper than Drake fine sandy loam, 1 to 3 percent slopes, and they have a wider range in texture. The texture of the surface soil ranges from fine sandy loam to clay loam. Both water erosion and wind erosion are very likely, and the content of lime is high.

A representative area of these soils is near the center of section 3, block C-41, Public school land.

Use and management.—The use of these soils is limited by their high content of lime and their susceptibility to erosion.

If dry-farmed, capability unit VIe-1; if irrigated, capability unit IVe-5; range site: High lime, high plains.

Kimbrough series

In this series are very shallow, moderately dark-colored, noncalcareous to strongly calcareous soils that have developed on thick beds of stonelike caliche. These soils have a loam to light clay loam surface soil. They have not been separated into types in this county because extreme shallowness is the most important characteristic that determines management. The vegetation consists of short grasses and a moderate to thick stand of broom snakeweed.

Kimbrough soils are associated with Potter and Arvana soils. They are on gentle slopes above the adjacent steep Potter soils. They are darker colored and less calcareous than the Potter soils and are underlain by harder caliche. They are shallower than the Arvana soils and less red.

Kimbrough soils have a small total acreage. They are not suited to cultivation.

Kimbrough soils, 1 to 5 percent slopes (KmC).—These soils have a brown to dark grayish-brown surface soil, 2 to 12 inches thick, that is underlain by hard, platy caliche.

Representative profile—

Location: 10.8 miles north of Lamesa on U.S. Highway 87, then 6.0 miles east on Farm Road 1210.

A₁₁ 0 to 5 inches, dark grayish-brown (10YR 4/2; 3/2, moist) light clay loam; weak, subangular blocky structure; sticky when wet, friable when moist, and slightly

hard when dry; few insect casts; roots penetrate the peds; many small calcium carbonate concretions; occasional caliche fragments throughout profile; noncalcareous but is strongly calcareous in small spots; clear boundary.

A₁₂ 5 to 8 inches, brown (10YR 5/3; 4/3, moist) light clay loam; weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; very few roots and little insect activity; soil contains calcium carbonate concretions, gravel, and rounded fragments of limestone; strongly calcareous; abrupt boundary.

D 8 inches +, hardened caliche; thick, platy, smooth upper surface and concretionary lower surface.

This soil ranges from 2 to 12 inches in depth. The depth varies greatly within small areas. The reaction ranges from noncalcareous to strongly calcareous. The darker colored areas generally are noncalcareous.

Included with these soils are small areas of Arvana fine sandy loam, shallow, 0 to 3 percent slopes.

Use and management.—Because of their shallow depth, these soils are not used for cultivated crops.

Capability unit VIe-3; range site: Shallow land, high plains.

Mansker series

In this series are dark-brown to yellowish-brown, strongly calcareous, droughty soils that are 10 to 20 inches deep. These soils have developed from strongly calcareous, medium- to fine-textured sediments. Their surface soil is fine sandy loam or clay loam and is underlain by fine sandy loam to clay loam. In most places many fragments and concretions of calcium carbonate are on the surface. The native vegetation consists of a thin cover of short grasses, mainly gramas, and a few catclaw, mesquite, and lotebush shrubs.

Mansker soils occur along Sulphur Springs Draw and in the eastern part of the county. They are associated with the Portales, Potter, Amarillo, and Zita soils. They are found in small areas within larger areas of Portales soils, and they surround areas of Potter soils. They are also on slope breaks between nearly level areas and gently sloping areas of Amarillo soils. Mansker soils are shallower than the Portales soils and are deeper than the Potter soils. They are shallower and lighter colored than the Zita soils and are more calcareous in the upper horizons.

Mansker soils have a small total acreage, some of which is used for cotton and grain sorghum. The grain sorghum often has chlorosis.

Mansker fine sandy loam, 1 to 3 percent slopes (MfB).—This soil has a brown to grayish-brown surface soil, 4 to 8 inches thick, that is slightly to strongly calcareous. Its very strongly calcareous subsoil is lighter colored than the surface soil and is underlain, at depths ranging from 12 to 22 inches, by white chalky earth. This material is slightly hard in most places.

This soil occurs mostly on slopes along Sulphur Springs Draw, in a belt 100 to 800 feet wide, between the higher lying Amarillo soils and the steeper Potter soils.

Representative profile—

Location: At the midpoint of the south section line of section 33, block M., E. L. and R. RR. survey.

A₁ 0 to 8 inches, brown (7.5YR 5/4; 4/4, moist) fine sandy loam; structureless; friable when moist and soft when dry; on the surface are a few, small, white concretions and fragments of calcium carbonate, 1 to 5 millimeters

in diameter; few small tubes and pores; strongly calcareous; clear boundary.

AC 8 to 16 inches, yellowish-brown (10YR 5/4; 4/4, moist) light sandy clay loam; weak, prismatic and weak, subangular blocky structure; sticky when wet, friable when moist, and slightly hard when dry; many calcium carbonate concretions; numerous insect burrows and worm casts; few fine roots; strongly calcareous; abrupt boundary.

C_{ea} 16 to 40 inches +, white (10YR 8/1; 7/1, moist) chalky earth; 20 percent of material is white concretions of calcium carbonate, as much as 25 millimeters in diameter.

In most places the surface of this soil is covered with small concretions of calcium carbonate less than 10 millimeters in diameter. The A horizon ranges from 4 to 8 inches in thickness. It is brown (7.5YR 5/4; 4/4, moist) to dark brown (10YR 4/3; 3/3, moist). Hue is 7.5YR to 10YR, value is 4 to 5, and chroma is 3 to 6. The A₁ horizon has, in local areas adjacent to sandy soil, accumulations of fine sand that are 4 to 8 inches thick in some places.

The AC horizon ranges from 6 to 16 inches in thickness and from fine sandy loam to clay loam in texture. It is yellowish red (5YR 5.5/8; 4/8, moist) to brown (10YR 5.5/3; 4.5/3, moist). Hue is 5YR to 10YR, value is 4.5 to 7, and chroma is 3 to 8.

The depth to the C_{ea} horizon ranges from 16 to 22 inches. The C_{ea} horizon is pink (7.5YR 7/4; 6/4, moist) to white (10YR 8/1; 7/1, moist). From 20 to 60 percent of the horizon consists of segregated, hard and soft, white (10YR 8/2; 7/2, moist) concretions of calcium carbonate as much as 40 millimeters in diameter. Hard or semihard, white (7.5YR 8/0) caliche occur in some places at depths ranging from 16 to 22 inches. Hard, platy caliche occurs erratically. The C horizon ranges from sandy clay loam to clay loam in texture and is light brownish gray (10YR 6/2, moist) to pink (7.5YR 7/4; 6/4, moist).

Included with this soil are small shallow areas of Potter soils and small areas of deeper soils that resemble Portales soils. The shallow Potter soils occur on slopes or on knolls; the deeper soils are in pockets. Other inclusions are small areas of noncalcareous soils that resemble Arvana soils and cultivated areas on the steeper slopes that have moderately severe erosion.

Use and management.—This soil is limited in its use because it is shallow and, consequently, has a low capacity for holding available moisture and plant nutrients. It is susceptible to moderate wind erosion and water erosion if it is cultivated.

If dry-farmed, capability unit IVE-4; if irrigated, IIIe-6; range site: Shallow land, high plains.

Mansker fine sandy loam, 0 to 1 percent slopes (MfA).—This soil is slightly darker colored and less calcareous than Mansker fine sandy loam, 1 to 3 percent slopes. It occurs within larger areas of Portales fine sandy loam, 0 to 1 percent slopes, or on nearly level benches adjacent to ancient drains.

A representative area is about 0.5 mile south and 100 feet east of the northeast corner of section 10, block 35, 7 N., T. and P. RR. survey.

Use and management.—The use of this soil is limited by its shallow depth and consequent low capacity for holding available moisture and plant nutrients. If cultivated, this soil is susceptible to moderate wind erosion, and water erosion.

If dry-farmed, capability unit IVE-4; if irrigated, IIIe-6; range site: High lime, high plains.

Mansker fine sandy loam, 3 to 5 percent slopes (MfC).—This soil occurs mainly on the slopes along Sulphur Springs Draw. Much of it has been cultivated with adjoining deep soils. Water has gullied a few areas, and in some areas wind and water have removed the entire soil surface.

A representative area is at the midpoint of the east side of section 77, block 35, T. 6 N.

Use and management.—The use of this soil is limited by its slope, shallow depth, and susceptibility to wind erosion and water erosion. Its best use is permanent grass.

If dry-farmed, capability unit VIe-1; if irrigated, capability unit IVE-5; range site: Shallow land, high plains.

Mansker clay loam, 0 to 1 percent slopes (MaA).—This soil has a brown to grayish-brown clay loam surface soil, 6 to 10 inches thick. The subsoil is lighter colored than the surface soil and is underlain by very strongly calcareous material at depths ranging from 14 to 22 inches. Most of this soil is in the eastern part of the county on the high plains.

Representative profile—

Location: 0.2 mile east and 100 feet south of northwest corner of section 5, block 1, J. Poitevent survey.

A_p 0 to 8 inches, brown (10YR 5/3; 3/3, moist) light clay loam; weak, subangular blocky structure; slightly sticky when wet, very friable when moist, and slightly hard when dry; thin lenses of pale-brown fine sandy loam in the upper 4 inches; few fine concretions of calcium carbonate; many roots, fine tubes, and insect burrows; strongly calcareous; gradual boundary.

AC 8 to 16 inches, grayish-brown (10YR 5/2; 3.5/2, moist) clay loam; very weak, prismatic and weak, subangular blocky structure; very porous; many concretions of calcium carbonate ranging from 2 to 10 millimeters in diameter; strongly calcareous; hard caliche fragments, 2 to 4 inches in diameter, make up 50 to 75 percent of the lower 4 inches; gradual boundary.

C_{ea} 16 to 26 inches, slightly hard, white caliche; layer is fractured and apparently permeable; clear boundary.

C 26 inches +, pink (7.5YR 8/4; 7/4, moist), soft, chalky earth; 50 percent or more of the material consists of soft, white concretions of calcium carbonate.

In most places the surface is covered with many concretions and fragments of calcium carbonate. The A horizon ranges from 6 to 10 inches in thickness. It is grayish brown (10YR 5/2; 4/2, moist) to a yellowish brown (10YR 5/4; 4/4, moist). Hue is 10YR, value is 4 to 5, and chroma is 2 to 4. This horizon is weakly to strongly calcareous.

The AC horizon is light clay loam or clay loam. It ranges from 6 to 12 inches in thickness. It is grayish brown (10YR 5/2; 3.5/2, moist) to yellowish brown (10YR 5/4; 4/4, moist). Value is 4 to 5 and chroma is 2 to 4.

The C_{ea} horizon is at depths ranging from 14 to 26 inches. It consists of material that ranges from white, hard, platy caliche to soft, pinkish-white (7.5YR 8/2; 7/2, moist), chalky earth. The hard, platy caliche occurs erratically.

The C horizon is generally soft, chalky earth.

Included with this soil are small areas of Portales clay loam, 0 to 1 percent slopes, and Amarillo sandy clay loam, 0 to 1 percent slopes. These areas are less than 1 acre in size. Also included are small areas of soils less than 10 inches deep that resemble Potter soils.

Use and management.—This soil is best suited to permanent grass. Its use is limited by the low capacity to hold available moisture and plant nutrients. If it is cultivated, this soil is susceptible to slight wind erosion.

If dry-farmed, capability unit IVE-4; if irrigated, capability unit IIIe-6; range site: High lime, high plains.

Mansker clay loam, 1 to 3 percent slopes (MaB).—This soil is lighter colored than Mansker clay loam, 0 to 1 percent slopes, and more strongly calcareous. Most of this soil is in the eastern part of the county on the high plains.

A representative area is 0.15 mile west and 100 feet south of the northeast corner of section 6, block 1, J. Poitevent survey.

Use and management.—The use of this soil is limited by the low capacity to hold available water and plant nutrients. Manage this soil with care because it is moderately susceptible to water erosion.

If dry-farmed, capability unit IVE-4; if irrigated, capability unit IIIe-6; range sites: Shallow land, high plains and Shallow land, rolling plains.

Mansker clay loam, 3 to 5 percent slopes (McC).—This soil is lighter colored and more calcareous than Mansker clay loam, 0 to 1 percent slopes, and has less profile development. It is adjacent to and below the caprock escarpment on the rolling plains. On the rolling plains, this soil occurs in fairly wide areas between the steeper Potter soils and the less sloping Bippus soils.

A representative area is 0.25 mile east and 100 feet north of the southwest corner of section 12, block 33, 7 N., T. and P. RR. survey.

Use and management.—All of this soil is in range. It is not suited to cultivation.

If dry-farmed, capability unit VIe-1; if irrigated, IVE-5; range site: Shallow land, rolling plains.

Miles series

This series consists of deep, well-developed, moderately sandy, reddish soils that occur on the rolling plains. The parent materials are waterlaid and consist of soft, calcareous, moderately sandy deposits.

Miles soils are associated with the Abilene, Bippus, and Mansker soils. They are on slightly higher, more convex slopes than the Abilene soils and are sandier and redder throughout the profile. They are less calcareous than the Bippus and Mansker soils and more strongly developed. Miles soils closely resemble the Amarillo soils of the high plains.

These soils are not extensive; all of the acreage is used for range.

Miles sandy clay loam, 1 to 3 percent slopes (MsB).—This soil has a reddish-brown surface soil, 6 to 10 inches thick. The subsoil is more clayey than the surface soil and is underlain by light-colored, soft caliche at depths ranging from 34 to 48 inches.

Representative profile—

Location: 0.6 mile west and 0.25 mile south of section 19, block 33, T. 4 N., T. and P. RR. survey.

- A₁ 0 to 6 inches, reddish-brown (5YR 4/3; 3/3, moist) sandy clay loam; weak, subangular blocky structure; sticky when wet, friable when moist, and hard when dry; many fine tubes and pores; few insect burrows and casts; many very fine roots; noncalcareous; clear boundary.
- B₂ 6 to 24 inches, reddish-brown (5YR 4/4; 3/4, moist) clay loam; moderate, medium, prismatic and moderate, fine, subangular blocky structure; very sticky when wet, firm when moist, and very hard when dry; common, very fine tubes and pores; few insect burrows and casts as much as 10 millimeters in diameter; roots readily penetrate the peds; noncalcareous; gradual boundary.
- B₃ 24 to 34 inches, reddish-brown (5YR 5/4; 4/4, moist) sandy clay loam; sticky when wet, friable when moist, and hard when dry; common threads and films of calcium carbonate; few waterworn pebbles; strongly calcareous; clear boundary.
- C_{ca} 34 to 46 inches, light reddish-brown (5YR 6/4; 5/4, moist) sandy clay loam; few waterworn pebbles; common concretions of calcium carbonate as much as 10 millimeters in diameter; very strongly calcareous.

The A₁ horizon ranges from 6 to 10 inches in thickness. The B₂ horizon is 18 to 30 inches thick. In some places the strongly calcareous B₃ horizon does not occur. The depth to the C_{ca} horizon ranges from 32 to 48 inches. The entire profile has a hue of 5YR.

Included with this soil are small areas that have a fine sandy loam surface soil. In most places these inclusions are slightly more sloping and higher lying than the surrounding areas.

Use and management.—All of this soil is in range. If you cultivate, manage this soil with care because it is susceptible to slight wind erosion and moderate water erosion.

If dry-farmed or irrigated, capability unit IIIe-1; range site: Hard land slopes, rolling plains.

Miles sandy clay loam, 0 to 1 percent slopes (MsA).—This soil has a thicker surface soil and subsoil than Miles sandy clay loam, 1 to 3 percent slopes, and it is slightly darker colored throughout the profile. It is less extensive than that soil but is in fairly large areas on the flat mesas.

A representative area is 0.45 mile southwest and 0.2 mile south of the stream and road crossing in the northern part of section 32, block 1.

Use and management.—All of this soil is in range. If it is cultivated, it is only slightly susceptible to wind and water erosion.

If dry-farmed, capability unit IIIec-1; if irrigated, capability unit IIe-1; range site: Hard land slopes, rolling plains.

Portales series

This series consists of friable, permeable, calcareous, grayish-brown soils. These soils range from 20 to 48 inches in thickness but, in most places, are between 24 and 30 inches thick. They have developed in limy sediments on plains and are underlain by thick, soft, whitish caliche. They are smooth and have slopes that range from 0 to 3 percent. In most places the slopes are 0 to 1 percent. These soils occur on nearly level, convex floors of playas and drainageways and on the gentle slopes that border these areas. They also occur in narrow strips surrounding playas or on the low shelves above them. The largest areas of these soils are in the northeastern part of the county on the high plains. The vegetation is short grasses, mainly buffalograss and gramas, and scattered brushy mesquite.

These soils are associated with Mansker, Zita, Amarillo, and Arch soils. They are deeper and darker colored than the Mansker soils. They are lighter colored than the Zita soil, which is noncalcareous to depths of 10 to 20 inches. Portales soils are normally shallower and not so red as the Amarillo soils, which are noncalcareous to depths of 18 inches or more. They are more susceptible to wind erosion than the Amarillo soils. They are deeper and darker colored than the Arch soils and contain less lime in the surface soil.

Portales soils are fairly extensive. They are used mostly for cultivated crops, particularly cotton and grain sorghum. Although much of the acreage is dry-farmed, these soils are well suited to irrigation.

Portales clay loam, 0 to 1 percent slopes (PcA).—This moderately deep soil has a very dark grayish-brown, calcareous surface soil that is underlain by lighter colored clay loam. The parent material is light brown to

white and very strongly calcareous. Areas of the soil, as much as 50 acres in size, occur on low-lying areas around playas. Other more nearly level, irregularly shaped areas are higher and are surrounded by Amarillo soils.

Representative profile—

Location: 0.3 mile south and 100 feet east of the northwest corner of section 3, block 1, J. Poitevent survey.

- A_{1p}** 0 to 8 inches, very dark grayish-brown (10YR 3/2; 2/2, moist) clay loam; moderate, coarse, prismatic and moderate, very fine, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; the upper 2 inches is dark-brown, structureless, heavy fine sandy loam; slightly calcareous; gradual boundary.
- A₁₂** 8 to 16 inches, dark-brown (10YR 4/3; 3/3, moist) clay loam; moderate, coarse, prismatic and moderate, very fine, subangular blocky structure; slightly sticky when wet, friable when moist, and hard when dry; many worm casts, root channels, and insect burrows; few hard calcium carbonate concretions; strongly calcareous; clear boundary.
- AC** 16 to 26 inches, brown (7.5YR 5/4; 4/4, moist) clay loam; moderate, coarse, prismatic and moderate, very fine, subangular blocky structure; friable when moist and very hard when dry; many hard concretions of calcium carbonate less than 1 millimeter in diameter; strongly calcareous; clear boundary.
- C_{ca}** 26 to 50 inches, white (10YR 8/2) and very pale brown (10YR 8/4) chalky earth that is almost clay in texture; about 30 percent of the material is hard concretions of calcium carbonate; very strongly calcareous; gradual boundary.
- C** 50 to 72 inches +, white (10YR 8/2), soft, chalky earth; as depth increases layer contains more very pale brown (10YR 8/4), heavy clay loam and less hard concretions. The A horizon ranges from 6 to 20 inches in thickness; the AC horizon is 10 to 20 inches thick. The thickness of the C_{ca} horizon is 24 to 48 inches.

Included with this soil are areas of reddish-brown soils that resemble Amarillo sandy clay loam, 0 to 1 percent slopes, except that they are calcareous throughout the profile. Other inclusions are scattered spots of Amarillo sandy clay loam, 0 to 1 percent slopes. Some areas of this soil have been winnowed by the wind to the extent that enough silt and clay particles have been blown away to change the texture of the plow layer. As a result of wind damage, these areas may have as much as 6 inches of the fine sandy loam in the plow layer.

Use and management.—If rainfall is greater than average, this soil will produce good yields of cotton, grain sorghum, grasses, and legumes. In the drier years, however, yields are lower than on the deep, nearly level fine sandy loams. Under irrigation, this is one of the most productive soils in the county, but only small acreages are irrigated. You should conserve as much of the water that falls on this soil as you can. If you cultivate this soil it will be susceptible to slight to moderate wind erosion and slight water erosion.

If dry-farmed, capability unit IIIec-1; if irrigated, capability unit IIe-1; range site: High lime, high plains.

Portales clay loam, 1 to 3 percent slopes (PcB).—This soil is somewhat lighter colored than Portales clay loam, 0 to 1 percent slopes. In some places it is slightly redder than the nearly level phase. In most places it has a brown surface soil that is underlain by grayish-brown clay loam. Although this soil is slightly steeper than Portales clay loam, 0 to 1 percent slopes, its slopes are less than 2 percent in most places.

Included with this soil are many areas of Amarillo sandy clay loam, 1 to 3 percent slopes, that are less than 2 acres in size. These inclusions make up about 10 percent of the mapping unit. Also included are a few patches of Mansker clay loam, 1 to 3 percent slopes, less than 1 acre in size. These inclusions make up less than 1 percent of the mapping unit.

A representative area of this soil is about 0.25 mile south and 0.1 mile west of the northeast corner of the northwest half of section 12, block 34, T. 3 N., T. and P. RR. survey.

Use and management.—This soil is used for cotton, grain sorghum, and other crops. The most efficient way to irrigate this soil is by the level-border method, but the limited supply of water restricts irrigation. Where cultivated, this soil is susceptible to slight wind erosion and moderate water erosion.

If dry-farmed or irrigated, capability unit IIIe-1; range site: High lime, high plains.

Portales fine sandy loam, 0 to 1 percent slopes (PfA).—This moderately deep soil has a brown, weakly calcareous to strongly calcareous surface soil that is underlain by soft, white caliche. It occurs mostly in large depressions, or playas, that appear to be ancient lake beds or waterways. It is also in narrow strips around these playas, mostly on the eastern side. In most places this soil is lower lying than are the adjacent Amarillo soils. It is bordered by the Mansker soils where there is a change in elevation.

In many places this soil has 3 to 6 inches of loamy fine sand in the plow layer. This may be the result of two kinds of erosion—the removal of the silt and clays by the wind or the accumulation of sand particles that have blown from higher lying, sandier areas onto the slightly depressed areas of this soil.

Representative profile—

Location: 0.4 mile west and 0.1 mile south of northeast corner of section 5, block 2, J. Poitevent survey.

- A_{1p}** 0 to 6 inches, brown (10YR 5/3; 4/3, moist) fine sandy loam; structureless; nonsticky when wet, very friable when moist, and soft when dry; few lenses of fine sand; slight surface crust; few subrounded and angular fragments of hard caliche; weakly calcareous; abrupt boundary.
- A₁₂** 6 to 12 inches, dark-brown (10YR 4/3; 3/3, moist) light sandy clay loam; very weak, prismatic and weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; few calcium threads; many small pores about 1 millimeter in diameter; few root cavities and worm casts; few pebbles less than 5 millimeters in diameter; strongly calcareous; gradual boundary.
- AC** 12 to 30 inches, pale-brown (10YR 6/3; 5/3, moist) sandy clay loam; weak, subangular blocky and granular structure; sticky when wet and friable when moist; more porous than A₁₂ horizon; many films and threads of calcium carbonate; strongly calcareous; gradual boundary.
- C_{ca}** 30 to 48 inches, very pale brown (10YR 7/3; 6/3, moist) clay loam; sticky when wet and slightly hard when dry; many fine concretions of calcium carbonate; very strongly calcareous.

The A horizon ranges from 6 to 20 inches in thickness. It is dark brown to grayish brown. The AC horizon ranges from 6 to 34 inches in thickness and is dark brown to very pale brown. The structure of the AC horizon is weak prismatic and weak subangular blocky in most places, but, in some places that contain many worm casts, it is granular.

The C horizon is very pale brown to white chalky material.

In some places the chalky material is mottled very pale brown and white.

Included with this soil are small areas of Mansker, Amarillo, and Arvana fine sandy loams that occur in small patches or on slight breaks in slopes. The included acreage is mostly Mansker fine sandy loam, 1 to 3 percent slopes.

Use and management.—You can get good yields of cotton, grain sorghum, legumes, and grasses if you irrigate or dry-farm. Apply nitrogen and phosphate for irrigated cotton, grain sorghum, and grasses. Use sprinkler, level-border, or level-furrow irrigation on this soil where enough water is available.

If dry-farmed, capability unit IIIe-2; if irrigated, capability unit IIe-2; range site: High lime, high plains.

Portales fine sandy loam, 1 to 3 percent slopes (Pfb).—This soil has thinner horizons than the corresponding horizons in Portales fine sandy loam, 0 to 1 percent slopes. It is slightly browner than that soil and has a reddish hue. Where this soil is adjacent to the Amarillo fine sandy loam, it has a reddish-brown surface soil and subsoil and is calcareous throughout the profile. Most of this soil is on slopes of less than 2 percent.

A representative area is in a cultivated field 0.8 mile north of the northwest corner of section 13, block 34, T. 5 N., T. and P. RR. survey, and 300 feet east of county road.

Use and management.—If you cultivate this soil, it is susceptible to moderate sheet, gully, and wind erosion. Sprinkler irrigation is used more than any other kind because of the limited water supply and the slope of the soil.

If dry-farmed or irrigated, capability unit IIIe-3; range site: High lime, high plains.

Potter series

In this series are very shallow, pale-brown to grayish-brown, strongly calcareous soils that are underlain by thick layers of soft or slightly hard caliche. These soils occur on the steep slopes of ancient drains where geologic erosion is still active. They are also on the escarpment that separates the high plains from the rolling plains. In slope, they range from 5 percent along the shallower drains to as much as 50 percent on the steeper escarpments, but in most places their slopes are between 8 and 30 percent.

These soils are associated with Kimbrough and Mansker soils. They are more calcareous and lighter colored than the Kimbrough soils and are underlain by softer caliche. They are steeper, shallower, and lighter colored than the Mansker soils.

Because of their very shallow depth and steep slopes, Potter soils are not suited to cultivation.

Potter soils, 8 to 30 percent slopes (PsG).—These grayish-brown soils range from fine sandy loam to clay loam in texture and from 2 to 10 inches in thickness. They are underlain by soft or slightly hard caliche that, in places, contains more than 50 percent free lime.

On the steeper slopes above ancient drainageways, Potter soils generally are associated with higher lying Amarillo soils. In these areas the rocklike fragments are missing. On the steep escarpment between the high plains and rolling plains, Potter soils generally have an accumulation of hard limestone fragments and some

sandstone and conglomerate rocks as much as 5 inches in diameter. In many places in these areas, the underlying material is soft. Apparently, the rocks on the surface are remains that were left when thin ledges and outcrops of stone were eroded.

Profile that has a fine sandy loam surface soil—

Location: 4.2 miles east of O'Donnell and 0.6 mile south.

A₁ 0 to 4 inches, grayish-brown (10YR 5/2; 4/2, moist) fine sandy loam; weak, prismatic and weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; many fine roots; many small calcium carbonate concretions as much as 5 millimeters in diameter; a few tubes and pores as much as 2 millimeters in diameter; many hard, rocklike fragments as much as 5 inches in diameter are on the surface; strongly calcareous; abrupt boundary.

A₁₂ 4 to 9 inches, pale-brown (10YR 6/3; 5/3, moist) fine sandy loam; weak, prismatic and weak, subangular blocky structure; slightly sticky when wet, friable when moist, and slightly hard when dry; many fine roots; few tubes and pores as much as 5 millimeters in diameter; some earthworm casts; some insect burrows as much as 5 millimeters in diameter; strongly calcareous; abrupt boundary.

C 9 to 14 inches +, white (10YR 8/2; 7/2, moist) slightly hard caliche that can be penetrated with a "sharp-shooter" spade; slightly platy in upper 3 inches and softer with depth; very strongly calcareous.

These soils are extremely variable. They have not been mapped in soil types, mainly because their shallowness is the main factor that determines how they are managed.

Included with these soils are small areas of Mansker soils.

Use and management.—Because of extreme shallowness and steep slopes, these soils are not suited to cultivation.

Capability unit, VIIe-2; range sites: Shallow land, high plains and Shallow land, rolling plains.

Randall series

In this series are dark-gray, poorly drained, noncalcareous to strongly calcareous soils that have accumulated on the floors of playas. These soils have very slow internal drainage and no external drainage. Following rainy seasons, these soils remain under water for extended periods.

Randall soils are not very extensive in this county. Most areas are less than 20 acres in size, but areas of Randall soils range from 5 to 125 acres. Some of the acreage is successfully cultivated except during periods of extremely high rainfall.

Randall clay (Rc).—This soil has a dark-gray, clayey surface soil, 6 to 12 inches thick. The surface soil is underlain by a tough, plastic, gray clay that has little profile development.

Representative profile—

Location: Northwest quarter of section 63, block 8, E. L. and R. RR. survey.

A₁ 0 to 5 inches, dark-gray (10YR 4/1; 3/1, moist) clay; fine, blocky and granular structure; very sticky when wet, very firm when moist, and very hard when dry; few fine roots; slightly calcareous; abrupt boundary.

A₁₂ 5 to 15 inches, dark-gray (7.5YR 4/0; 3/0, moist) clay; strong, fine, blocky structure; very sticky when wet, very firm when moist, and very hard when dry; few fine roots; many tubes and pores; few earthworm casts; some threads of calcium carbonate; strongly calcareous; gradual boundary.

AC 15 to 46 inches, gray (10YR 5/1; 4/1, moist) clay; strong, fine blocky structure; very sticky when wet, very firm when moist, and very hard when dry; few earth-

worm casts; common soft concretions of calcium carbonate; strongly calcareous; gradual boundary.

- C₂ 46 to 55 inches, gray (10YR 6/1; 5/1, moist) clay; strong, fine blocky structure; very sticky when wet, very firm when moist, and very hard when dry; many calcium carbonate concretions that impart a mottling effect; very strongly calcareous; rests on soft, white caliche.

The A horizon ranges from 10 to 24 inches in thickness. Hue is 7.5YR to 10YR, value is 3 to 4, and chroma is 0 to 1. Structure ranges from moderate, fine, blocky to strong, medium, blocky. The reaction is alkaline to strongly calcareous.

The AC horizon ranges from 10 to 40 inches in thickness. Hue is 7.5YR to 10YR, value is 5 to 7, chroma is 0 to 3. Structure ranges from moderate, coarse, blocky to strong, fine, blocky. The reaction is alkaline to strongly calcareous.

Included with this soil are some areas that have a clay loam or fine sandy loam surface layer, 1 to 4 inches thick. These inclusions generally occur on the outer edge of the playas. They are the result of material being blown or washed from surrounding sandier soils.

Use and management.—Because of frequent flooding, this soil is limited in use.

Capability unit VIw-1.

Randall fine sandy loam, overblown (Ro).—This soil has a grayish-brown to brown, friable fine sandy loam surface soil, about 20 inches thick, that contains thin lenses of pale-brown loamy fine sand. The surface soil is underlain by a layer of dark grayish-brown sandy clay or clay loam, 4 to 6 inches thick. This layer is transitional to dark-gray clay. This soil developed in sandy material that ranges from 6 to 30 inches in thickness. The sandy material was deposited by wind and water on Randall clay or, in some places, on soils that resemble Zita or Lubbock soils. Lubbock soils are not mapped in this county.

A representative area is in the northwest corner of labor 22, league 4, Taylor County school land.

Use and management.—You can successfully cultivate this soil except during years of extremely high rainfall. This soil is seldom completely covered by water. After heavy rains, the surface normally is dry within a week. Most of the acreage is used to grow cotton and grain sorghum. Generally, high yields of these crops can be expected.

If dry-farmed or irrigated, capability unit IVw-1.

Spur series

In this series are brown to very dark grayish-brown, friable, calcareous soils that are on the flood plains of ancient drains. These soils consist of alluvium that has accumulated at the base of sloping Potter and Mansker soils on either side of the drains. Runoff is slow to moderate and internal drainage is moderate. These soils are flooded occasionally, but the water recedes quickly and causes little damage.

Spur soils are not extensive. Some of the acreage is used for cotton and grain sorghum.

Spur clay loam (Sc).—This soil has a very dark grayish-brown surface soil, 16 to 28 inches thick. Its subsoil is lighter colored and more calcareous than the surface soil. The hazard of wind erosion and water erosion is only slight.

Representative profile—

Location: 0.5 mile east and 0.25 mile north of southwest corner of section 11, block 33, 7 N.

A 0 to 20 inches, very dark grayish-brown (10YR 3/2; 2/2, moist) clay loam; moderate, coarse, prismatic and mod-

erate, very fine, subangular blocky structure; sticky when wet, firm when moist, and hard when dry; many fine roots as much as 1 millimeter in diameter; numerous worm casts and pore spaces; many concretions of calcium carbonate as much as 1 millimeter in diameter; strongly calcareous; gradual boundary.

- AC 20 to 40 inches +, brown (10YR 5/3; 4/3, moist) clay loam; moderate, coarse, prismatic structure; sticky when wet, firm when moist, and hard when dry; few fine roots that penetrate the peds; many worm casts and insect burrows; numerous concretions of calcium carbonate less than 1 millimeter in diameter and few more than 1 millimeter in diameter; strongly calcareous to very strongly calcareous.

The A horizon ranges from 16 to 28 inches in thickness. It is grayish brown (10YR 5/2; 4/2, moist) to very dark grayish brown (10YR 3/2; 2/2, moist). In places earthworms have reworked as much as 50 percent of this horizon. In some areas, the entire profile contains fragments and concretions of calcium carbonate that are less than 2 millimeters across. The A_{1p} horizon normally is 6 inches thick. In some areas, its texture is a light clay loam because sand has been deposited.

The AC horizon is clay loam or heavy clay loam and is 16 to 32 inches thick. Color ranges from brown (7.5YR 5/4; 4/4, moist) to very dark grayish brown (10YR 3/2; 2/2, moist). Hue is 7.5YR to 10YR, value is 3 to 6, and chroma is 2 to 4. This horizon is very slightly calcareous to very strongly calcareous. Apparently, there has been very little insect and worm activity. The AC horizon has very few fine tubes and pores. Prominent clay films are on the prism faces.

The horizons underlying the AC horizon are lighter colored and more calcareous with increasing depth. They contain many concretions and fragments of calcium carbonate. Material that appears to be buried soils occurs below the AC horizon in some places.

Included with this soil are small, lower lying areas that have received more water. Consequently, they are noncalcareous to depths of 10 to 30 inches.

Use and management.—This soil is very productive. It is used for cotton, grain sorghum, and other crops. Its management needs are not exacting, because it is only slightly susceptible to wind erosion and water erosion, even under cultivation.

If dry-farmed, capability unit, IIIec-1; if irrigated, capability unit IIe-1; range sites: Bottom land, rolling plains and Bottom land, high plains.

Spur fine sandy loam (Sf).—This soil is sandier than Spur clay loam and lighter colored. It ranges from brown to pale brown throughout the profile. It is susceptible to slight water erosion and moderate wind erosion. Most of this soil is northwest of Lamesa along Sulphur Springs Draw.

A representative area is 0.2 mile east and 0.2 mile north of the southwest corner of section 9, block 34, 6 N.

Use and management.—This soil is used for cotton, grain sorghum, and other crops. It needs to be managed to prevent erosion, particularly wind erosion.

If dry-farmed, capability unit IIIe-2; if irrigated, capability unit IIe-2; range site: Bottom land, high plains.

Stony rough land, Potter material

This miscellaneous land type consists of rough, broken, stony land. Most of this land is on the escarpment that separates the high plains from the rolling plains.

Some areas have a 2- to 4-inch layer of grayish-brown, calcareous soil that is similar to the upper layer of Potter soils. Potter and Mansker soils are in pockets that are only a few feet across. These small pockets have a thin cover of side-oats grama, sand dropseed, and

some little bluestem. They also have a moderately thick stand of redberry juniper.

This miscellaneous land type is not extensive. Most of it is not accessible to livestock.

Stony rough land, Potter material (Sr).—Most of this miscellaneous land type occurs on steep slopes that are almost vertical in places. About 85 percent of the surface is covered with small fragments of limestone and a few boulders, 1 to 3 feet across. There is little soil development.

Use and management.—This land is not suited to crops. Its use for grazing is very limited because of the steep slopes and sparse vegetation.

Capability unit VIIc-1; range sites: Rough broken land, high plains and Rough breaks, rolling plains.

Tivoli series

The soils in this series are deep, light-colored, loose sands that have developed from material deposited by wind. These soils are in the west-central part of the county, mostly on dunes that have short, choppy slopes with gradients as steep as 20 percent. They occur at some of the highest elevations in the county. The vegetation is mainly shin oak and includes a sparse stand of tall grasses.

These soils are associated with Brownfield soils, which occur on lower lying areas adjacent to Tivoli soils.

Only one Tivoli soil is mapped in Dawson County. This soil is not extensive and is not suited to cultivation.

Tivoli fine sand (Tv).—This soil has a brown surface soil, 4 to 8 inches thick, that is slightly darkened by organic matter. The surface soil is underlain by pale-brown to yellowish fine sand to a depth of many feet.

Representative profile—

Location: Northwest part of section 78, block M, E. L. and R. RR. survey.

- A 0 to 8 inches, brown (10YR 5/3; 4/3, moist) fine sand; single grain (structureless); loose when dry; many fine roots; few organic stains; noncalcareous; diffuse boundary.
- C 8 to 72 inches +, pale-brown (10YR 6/3; 5/3, moist) fine sand; structureless; loose when dry; is coarser with increasing depth; contains very few lenses of clay; noncalcareous.

Thin lenses of fine-textured material occur in places at depths of 40 to 70 inches.

Use and management.—This soil is not suited to cultivated crops. Its use is limited because it is highly susceptible to wind erosion and its capacity to hold available moisture and plant nutrients is very low.

Capability unit VIIc-1; range site: Sand hill, high plains.

Vernon series

In this series are reddish-brown soils that are underlain by redbed materials. These soils occur on local knobs or hogbacks on the rolling plains. In places small areas are very severely eroded.

These soils are not extensive. They are not suited to cultivation.

Vernon soils, 1 to 8 percent slopes (VeD).—These soils have a reddish-brown clay surface soil, less than 10 inches thick, that is darkened to some extent by organic matter. The surface soil is underlain by redbed mate-

rial that is very sticky when wet and very hard when dry.

Representative profile—

Location: 300 feet east and 200 feet south of stream and road crossing in the northern part of section 32, block 1, J. Poitevent survey.

- A₁ 0 to 6 inches, reddish-brown (2.5YR 5/4; 4/4, moist) clay; moderate, fine, irregular blocky structure; very sticky when wet, friable when moist, and hard when dry; few fine roots; many, very fine, round and angular pebbles on the surface and throughout the horizon; strongly calcareous; clear boundary.
- C 6 to 40 inches +, weak-red (10R 4/4; 3/4, moist) thin-bedded clay or shaly clay redbeds; very sticky and very plastic when wet, very firm when moist, and very hard when dry; few, very fine roots; interbedded pockets of blue-green, calcareous shaly clay; strongly calcareous.

These soils have slopes that range from 1 to 10 percent. In most places, however, the slopes are 3 to 6 percent.

Included with this soil are small areas that are rough and gullied. The gullies are as much as 8 feet deep and form an intricate network. They tend to have vertical sides. The redbed material is exposed in these gullies. It consists mostly of shaly, reddish-brown (2.5YR 4/4; 3/4, moist) clay. It also contains a few pockets of blue-green shale and some interbedded ledges of semihard sandstone, generally 1 to 5 inches thick. Many waterworn pebbles as much as 3 inches in diameter are on the surface.

Use and management.—Because these soils are generally on steep slopes, are shallow, and are highly susceptible to water erosion, they are not suited to cultivation.

Capability unit VIe-3; range site: Shallow hard land, rolling plains.

Vona series

This series consists of grayish-brown to light-brown sandy soils that are neutral to weakly alkaline. The parent materials are calcareous sands that have been deposited by wind on low-lying, nearly level areas. These areas have concave slopes that are less than 2 percent. The vegetation consists of thick stands of sand sage; some shin oak, yucca, sand dropseed, side-oats grama, and blue grama; and very few mesquite trees.

Vona soils are normally associated with Amarillo, Brownfield, Arch, and Drake soils.

Only one Vona soil has been mapped in Dawson County. This soil is not very extensive. It is on the high plains and is used mostly for range.

Vona loamy fine sand, 0 to 3 percent slopes (VoB).—This soil has a brown to grayish-brown surface soil, 10 to 22 inches thick, that is noncalcareous to slightly calcareous. The subsoil is very pale brown to brown, light fine sandy loam, 10 to 18 inches thick. It is underlain at depths from 26 to 40 inches by white to light-gray chalky material.

Representative profile—

Location: 0.5 mile west and 100 feet north of northwest corner of section 20, block 35, T. 6 N., T. and P. RR. survey.

- A₁₁ 0 to 5 inches, grayish-brown (10YR 5/2; 4/2, moist) loamy fine sand; structureless; nearly loose when moist and loose when dry; many fine roots and organic stains; thin crust of wind deposited silty material on surface; noncalcareous; clear boundary.
- A₁₂ 5 to 20 inches, pale-brown (10YR 6/3; 5/3, moist) loamy fine sand; structureless; nearly loose when moist and loose when dry; fewer roots than in A₁₁ horizon; noncalcareous; gradual boundary.

B 20 to 30 inches, brown (10YR 5/3; 4/3, moist) light fine sandy loam; weak, prismatic structure; slightly sticky when wet and very friable when moist; noncalcareous; abrupt boundary.

C_{ca} 30 to 48 inches +, light-gray (10YR 7/2; 6/2, moist) sandy clay loam; sticky when wet and friable when moist; strongly calcareous.

The A horizon ranges from 10 to 22 inches in thickness. It is grayish-brown (10YR 5/2; 4/2, moist) to light brown (7.5YR 6/4; 5/4, moist). Reaction is neutral to calcareous.

The B horizon ranges from 10 to 18 inches in thickness. It is very pale brown (10YR 8/3; 6/3, moist) to brown (10YR 5/3; 4/3, moist). Reaction is noncalcareous to strongly calcareous.

The depth to the C_{ca} horizon ranges from 26 to 40 inches. Color ranges from white (10YR 8/1; 7/1, moist) to light brownish gray (10YR 6/2; 5/2, moist). Reaction is strongly calcareous.

Use and management.—Most of this soil is in range, but a small acreage is in grain sorghum and cotton. This soil is highly susceptible to wind erosion where it is cultivated.

If dry-farmed, capability unit VIe-2; if irrigated, capability unit IVe-6; range site: Sandy land, high plains.

Zita series

In this series are brown to dark grayish-brown soils that are noncalcareous to depths of 10 to 24 inches. These soils are underlain by strongly calcareous parent materials.

Zita soils occur in depressions or on benches where they are associated with Amarillo and Portales soils. They are darker colored and less red than the Amarillo soils, which have a distinct layer of calcium carbonate below a depth of 36 inches. The layer of calcium carbonate in the Zita soils is generally at depths of 18 to 22 inches, but in some places it is almost 30 inches deep. Zita soils are darker colored than Portales soils, which are weakly calcareous to a depth of about 6 inches.

Only one Zita soil is mapped in Dawson County. This soil is not extensive and is used for cultivated crops.

Zita fine sandy loam, 0 to 1 percent slopes (ZfA).—This soil has a brown surface soil, 4 to 10 inches thick. Its subsoil is a dark grayish-brown, noncalcareous material that is underlain by pale-brown to white caliche at depths ranging from 18 to 30 inches. It receives runoff from higher soils and is susceptible to moderate wind erosion where it is cultivated.

Representative profile—

Location: 0.2 mile south of U.S. Highway 180, 6 miles west of Lamesa.

A_{1p} 0 to 8 inches, brown (10YR 5/3; 4/3, moist) fine sandy loam; structureless; slightly sticky when wet, very friable when moist, and soft when dry; noncalcareous; gradual boundary.

A₁₂ 8 to 14 inches, dark grayish-brown (10YR 4/2; 3/2, moist), heavy fine sandy loam; weak, prismatic and weak, subangular blocky structure; noncalcareous; clear boundary.

AC 14 to 24 inches, dark-brown (10YR 4/3; 3/3, moist) sandy clay loam; weak, prismatic and weak, subangular blocky structure; upper part is noncalcareous; lower 4 inches has threads and films of calcium carbonate; clear boundary.

C_{ca} 24 to 30 inches, pale-brown (10YR 6/3; 5/3, moist) sandy clay loam; sticky when wet, friable when moist, and hard when dry; very strongly calcareous; clear boundary.

C₁ 30 to 42 inches, mixed light-gray (10YR 7/2) and brown (10YR 5/3), with some white (10YR 8/2), sandy clay loam; very strongly calcareous; gradual boundary.

C₂ 42 to 48 inches +, pale-brown (10YR 6/3; 5/3, moist) sandy clay loam; very strongly calcareous.

The A horizon ranges from 4 to 10 inches in thickness. Hue is 7.5YR to 10YR, value is 4 to 5, and chroma is 2 to 5. Some areas have a weak B horizon.

The AC horizon ranges from 10 to 20 inches in thickness and in a few places is more than 20 inches thick. Hue is 7.5YR to 10YR, value is 3 to 4, and chroma is 1 to 3.

Use and management.—This soil produces good yields of cotton and other crops. Crops may be benefited at times by runoff from higher lying soils. Because the soil is susceptible to moderate wind erosion, it must be managed carefully where it is cultivated.

If dry-farmed, capability unit IIIe-2; if irrigated, capability unit IIe-2; range site: Mixed land, high plains.

Use and Management of Soils

This section consists of four main parts. The first part describes land capability classification and discusses use and management for each capability unit, or management group. The second part consists of a table that gives, for each soil commonly cultivated, estimated yields of dryland and irrigated cotton and grain sorghum under two levels of management. In the third part, general practices of soil management are discussed. The fourth part describes range management and lists the plants that make up the climax vegetation in each range site.

Capability Grouping

Land capability classification is a grouping of soils into capability units, subclasses, and classes according to their hazards and limitations in use.

The capability class is the broadest division of the system and is shown by a Roman numeral. Soils in classes I through IV are suited to cultivated crops, pasture or range, and wildlife habitats. Those in classes V through VIII are suited to pasture, range, or wildlife habitats but are not suited to cultivation. Although eight classes are recognized in the United States, only five of these classes are in Dawson County. This county has no soil in classes I, V, and VIII.

Limitations and hazards are the basis for grouping soils into capability classes. The dominant kind of hazard that restricts the use of a soil determines the subclass of the soil. The subclass is indicated by a small letter that follows the Roman numeral, for example, IIe. In Dawson County, the subclasses are designated by the letters "e", "w", "s", and "c". The dominant hazard of soils in subclass "e" is susceptibility to both wind erosion and water erosion. Soils in subclass "w" are limited mainly by an excess of water. Soils that form the bed of many of the playas are in subclass "w". The main limitation of the soils in subclass "s" is some detrimental characteristic of the soil itself. The stony, rough land on the caprock escarpment is in subclass "s" because it has developed very little soil and the topography limits its use, even for grazing. Soils that have a slight to moderate hazard of wind erosion and moderate limitations because of climate are in subclass "ec". The dou-

ble subclass "ec" indicates that erosion and climate limitations are about equal in importance to the safe use and management of the soils in this subclass.

The capability unit consists of soils that are nearly alike in their degree of limitations and hazards, their suitability for plant growth, and their response to management. The capability unit is essentially a management group of soils, for the soils in the unit respond to similar management in about the same way. One or more soils make up a capability unit. The symbol used to identify a land capability unit is a Roman numeral designating the class, a small letter designating the subclass, and an Arabic numeral designating the unit; for example, IIIe-1.

In the outline that follows are the capability classes, subclasses, and units in Dawson County and a brief description of the soils that make up these classification groups.

Class II.—Soils having some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe: Irrigated soils susceptible to slight wind or water erosion if not protected.

Unit IIe-1: Nearly level, reddish-brown clay loams and sandy clay loams with high capacity for holding water and plant nutrients.

Class III.—Soils having severe limitations that reduce the choice of plants, require special conservation, or both.

Subclass IIIec: Soils that are droughty and susceptible to slight wind or water erosion if not protected.

Unit IIIec-1 (IIe-1, irrigated): Nearly level, reddish-brown clay loams and sandy clay loams with high capacity for holding water and plant nutrients.

Subclass IIIe: Soils susceptible to moderate water erosion and moderate or slight wind erosion if not protected.

Unit IIIe-1: Gently sloping, dark-brown to reddish-brown clay loams and sandy clay loams that have high capacity for holding water and plant nutrients.

Unit IIIe-2 (IIe-2, irrigated): Nearly level, deep fine sandy loams that are very droughty and have a moderate capacity for holding water and plant nutrients.

Unit IIIe-3: Gently sloping, deep fine sandy loams that have a moderate capacity for holding moisture and plant nutrients.

Class IV.—Soils having very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe: Soils susceptible to moderate to severe wind erosion and slight to severe water erosion if not protected.

Unit IVe-1 (IIIe-4, irrigated): Light-gray to light brownish-gray fine sandy loams, high in lime.

Unit IVe-2: Light-brown clay loam that is sloping and susceptible to moderate to severe erosion.

Unit IVe-3 (IIIe-5, irrigated): Deep, light-colored sandy soils that have a low capacity for holding plant nutrients and moisture.

Unit IVe-4 (IIIe-6, irrigated): Reddish-brown to brown, shallow soils.

Subclass IVw: Soils that are severely limited by excess water.

Unit IVw-1: Dark-colored fine sandy loam in shallow playas.

Class VI.—Soils having severe limitations that make them unsuited to cultivation and limit their use largely to pasture, range, or wildlife cover.

Subclass VIe: Soils susceptible to very severe water erosion or wind erosion if not protected.

Unit VIe-1 (IVe-5, irrigated): Light-brown to brownish-gray soils on short, steep slopes.

Unit VIe-2 (IVe-6, irrigated): Light-colored, deep fine sands that have a low capacity to hold plant nutrients.

Unit VIe-3: Very shallow, nearly level to sloping soils.

Subclass VIw: Soils that are limited in their use by excess water.

Unit VIw-1: Dark-colored, poorly drained soil in playa beds.

Class VII.—Soils having severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, or wildlife cover.

Subclass VIIe: Soils susceptible to very severe wind or water erosion if not protected.

Unit VIIe-1: Deep, light-colored, extremely sandy soil.

Unit VIIe-2: Grayish-brown, very steep, shallow soils.

Subclass VIIs: Soil that has root-zone limitations.

Unit VIIs-1: Stony, rough, steep sloping land.

Table 3 gives the capability units for the soils in Dawson County and some of the important characteristics that influence the capability of these soils.

Management by capability units

In this subsection, the soils of Dawson County are listed in their capability units, or management groups, and characteristics that affect their management are given. The uses of the soils are stated, and management is suggested for dryland farming and for irrigated farming. A few of the groups have a different capability unit when the soils are irrigated than when they are dry-farmed. If the irrigated capability unit differs from the dry-farmed unit, the irrigated unit is given in parentheses following the dry-farmed unit.

Engineers in the Soil Conservation Service and other qualified specialists will help you plan an irrigation system.

CAPABILITY UNIT IIIec-1 (IIe-1, IRRIGATED)

This group consists of reddish-brown clay loams and sandy clay loams that are level or nearly level. They are:

Abilene clay loam, 0 to 1 percent slopes.
Amarillo sandy clay loam, 0 to 1 percent slopes.
Bippus clay loam, 0 to 1 percent slopes.
Miles sandy clay loam, 0 to 1 percent slopes.
Portales clay loam, 0 to 1 percent slopes.
Spur clay loam.

TABLE 3.—*Capability units, erosion hazard, depth, texture, and permeability of the soils in Dawson County*

Soil	Capability unit		Erosion hazard		Depth	Texture ¹	Permeability
	Dryland	Irrigated	Wind	Water			
Abilene clay loam, 0 to 1 percent slopes	IIIec-1...	IIe-1....	Slight.....	(²).....	Deep.....	Fine.....	Slow.
Amarillo fine sandy loam, 0 to 1 percent slopes.	IIIe-2....	IIe-2....	Moderate....	(²).....	Deep.....	Moderately coarse.	Moderate.
Amarillo fine sandy loam, 1 to 3 percent slopes.	IIIe-3....	IIIe-3....	Moderate....	Moderate....	Deep.....	Moderately coarse.	Moderate.
Amarillo loamy fine sand, 0 to 3 percent slopes.	IVe-3....	IIIe-5....	High.....	Moderate....	Deep.....	Coarse.....	Moderate.
Amarillo sandy clay loam, 0 to 1 percent slopes.	IIIec-1....	IIe-1....	Slight.....	(²).....	Deep.....	Fine.....	Moderate.
Amarillo sandy clay loam, 1 to 3 percent slopes.	IIIe-1....	IIIe-1....	Slight.....	Moderate....	Deep.....	Fine.....	Moderate.
Arch fine sandy loam, 0 to 1 percent slopes.	IVe-1....	IIIe-4....	High.....	(²).....	Moderately deep.	Moderately coarse.	Moderately rapid.
Arch loamy fine sand, 0 to 3 percent slopes, overblown.	IVe-3....	IIIe-5....	High.....	(²).....	Moderately deep.	Coarse.....	Moderate.
Arvana fine sandy loam, 1 to 3 percent slopes.	IIIe-3....	IIIe-3....	Moderate....	Moderate....	Moderately deep.	Moderately coarse.	Moderate.
Arvana fine sandy loam, 0 to 1 percent slopes.	IIIe-2....	IIe-2....	Moderate....	(²).....	Moderately deep.	Moderately coarse.	Moderate.
Arvana fine sandy loam, shallow, 0 to 3 percent slopes.	IVe-4....	IIIe-6....	Moderate....	Moderate....	Shallow....	Moderately coarse.	Moderate.
Arvana loamy fine sand, 0 to 3 percent slopes.	IVe-3....	IIIe-5....	High.....	Moderate....	Moderately deep.	Coarse.....	Moderate.
Bippus clay loam, 1 to 3 percent slopes..	IIIe-1....	IIIe-1....	Slight.....	Moderate....	Moderately deep.	Fine.....	Moderate.
Bippus clay loam, 0 to 1 percent slopes..	IIIec-1....	IIe-1....	Slight.....	(²).....	Moderately deep.	Fine.....	Moderate.
Bippus clay loam, 3 to 5 percent slopes..	IVe-2....	IVe-2....	Slight.....	High.....	Moderately deep.	Fine.....	Moderate.
Brownfield fine sand, thin surface, 0 to 3 percent slopes.	IVe-3....	IIIe-5....	High.....	(²).....	Deep.....	Coarse.....	Moderate.
Brownfield fine sand, thick surface, 0 to 3 percent slopes.	VIe-2....	IVe-6....	Very high..	(²).....	Deep.....	Coarse.....	Moderate.
Brownfield fine sand, 0 to 3 percent slopes, eroded.	VIe-2....	IVe-6....	Very high..	(²).....	Deep.....	Coarse.....	Moderate.
Drake fine sandy loam, 1 to 3 percent slopes.	IVe-1....	IIIe-4....	High.....	Moderate....	Deep.....	Moderately coarse.	Moderately rapid.
Drake soils, 3 to 5 percent slopes.....	VIe-1....	IVe-5....	High.....	High.....	Deep.....	Fine to moderately coarse.	Moderately rapid.
Kimbrough soils, 1 to 5 percent slopes...	VIe-3....	(³).....	Moderate....	Moderate....	Very shallow.	Variable....	Variable.
Mansker fine sandy loam, 0 to 1 percent slopes.	IVe-4....	IIIe-6....	Moderate....	(²).....	Shallow....	Moderately coarse.	Moderately rapid.
Mansker fine sandy loam, 1 to 3 percent slopes.	IVe-4....	IIIe-6....	Moderate....	Moderate....	Shallow....	Moderately coarse.	Moderately rapid.
Mansker fine sandy loam, 3 to 5 percent slopes.	VIe-1....	IVe-5....	High.....	High.....	Shallow....	Moderately coarse.	Moderately rapid.
Mansker clay loam, 0 to 1 percent slopes.	IVe-4....	IIIe-6....	Slight.....	(²).....	Shallow....	Fine.....	Moderate.
Mansker clay loam, 1 to 3 percent slopes.	IVe-4....	IIIe-6....	Slight.....	Moderate....	Shallow....	Fine.....	Moderate.
Mansker clay loam, 3 to 5 percent slopes.	VIe-1....	IVe-5....	Slight.....	High.....	Shallow....	Fine.....	Moderate.
Miles sandy clay loam, 1 to 3 percent slopes.	IIIe-1....	IIIe-1....	Slight.....	Moderate....	Deep.....	Fine.....	Moderate.
Miles sandy clay loam, 0 to 1 percent slopes.	IIIec-1....	IIe-1....	Slight.....	(²).....	Deep.....	Fine.....	Moderate.
Portales clay loam, 0 to 1 percent slopes.	IIIec-1....	IIe-1....	Slight to moderate.	(²).....	Moderately deep.	Fine.....	Moderate.
Portales clay loam, 1 to 3 percent slopes.	IIIe-1....	IIIe-1....	Moderate....	Moderate....	Moderately deep.	Fine.....	Moderate.
Portales fine sandy loam, 0 to 1 percent slopes.	IIIe-2....	IIe-2....	Moderate....	(²).....	Moderately deep.	Moderately coarse.	Moderately rapid.
Portales fine sandy loam, 1 to 3 percent slopes.	IIIe-3....	IIIe-3....	Moderate....	Moderate....	Moderately deep.	Moderately coarse.	Moderately rapid.
Potter soils, 8 to 30 percent slopes.....	VIIe-2....	(³).....	Slight.....	High.....	Very shallow.	Variable....	Variable.
Randall clay.....	VIw-1....	(³).....	Moderate....	(²).....	Deep.....	Fine.....	Very slow.
Randall fine sandy loam, overblown....	IVw-1....	IVw-1....	Moderate....	(²).....	Deep.....	Moderately coarse.	Very slow.
Spur clay loam.....	IIIec-1....	IIe-1....	Slight.....	(²).....	Deep.....	Fine.....	Moderate.

See footnotes at end of table.

TABLE 3.—*Capability units, erosion hazard, depth, texture, and permeability of the soils in Dawson County—Continued*

Soil	Capability unit		Erosion hazard		Depth	Texture ¹	Permeability
	Dryland	Irrigated	Wind	Water			
Spur fine sandy loam.....	IIIe-2....	IIf-2....	Moderate...	(²).....	Deep.....	Moderately coarse.	Moderately rapid.
Stony rough land, Potter material.....	VIIIs-1....	(³).....	Slight.....	High.....	Variable....	Variable.....	Variable.
Tivoli fine sand.....	VIIe-1....	(³).....	Very high...	(²).....	Deep.....	Coarse.....	Rapid.
Vernon soils, 1 to 8 percent slopes.....	VIe-3....	(³).....	Slight.....	Very high...	Very shallow.	Fine.....	Very slow.
Vona loamy fine sand, 0 to 3 percent slopes.	VIe-2....	IVe-6....	Very high...	(²).....	Moderately deep.	Coarse.....	Moderately rapid.
Zita fine sandy loam, 0 to 1 percent slopes.	IIIe-2....	IIf-2....	Moderate...	(²).....	Moderately deep.	Moderately coarse.	Moderate.

¹ Fine-textured soils are clays to sandy clay loams; moderately coarse textured soils are fine sandy loams; coarse-textured soils are loamy fine sands and fine sands.

² Normally these soils have no significant hazard of water erosion,

but areas near the upper limits of the slope range may have a slight erosion hazard.

³ Not suitable for irrigation.

All of these soils except Spur clay loam are on uplands. Lack of moisture limits production on these soils. They are susceptible to slight wind erosion and water erosion. They have, however, a high capacity for holding water and plant nutrients.

The main cash crop on these soils is cotton. Other cash crops are grain sorghum and small grain, which leave residue that helps reduce wind erosion. Vetch, Austrian winter peas, and cowpeas improve the soil and also can be harvested for hay. Alfalfa can be grown under irrigation.

Dryland.—Use a cropping system that, about half of the time, provides grain sorghum, small grain, or some other crop that leaves a large amount of residue on the ground. If you stubble mulch the residue, this prevents its rapid decomposition and adds organic matter to the soil. In addition, the mulch prevents erosion by providing cover and keeping the soil rough. During or following years of low rainfall, when there is not enough cover to prevent soil blowing, chisel or list the soil so that it will be cloddy and rough. To maintain tilth, plant a deep-rooted legume or grass in the cropping system. The legume supplies nitrogen, which the crops that follow the legume can use. Farming on the contour and a complete terrace system on long slopes will control water erosion and save precious water for crops.

Irrigated.—The soils in this group are very productive if they are irrigated. They need, however, management in addition to that suggested for dryland farming. Add commercial fertilizer to maintain high yields. Deep-rooted legumes can be grown to maintain tilth and to supply nitrogen for crops that follow the legumes. Use conservation irrigation. These soils are suitable for level-border, level- or graded-furrow, and sprinkler irrigation.

CAPABILITY UNIT IIIe-1

This group consists of dark-brown to reddish-brown clay loams and sandy clay loams that are gently sloping. They are:

- Amarillo sandy clay loam, 1 to 3 percent slopes.
- Bippus clay loam, 1 to 3 percent slopes.
- Miles sandy clay loam, 1 to 3 percent slopes.
- Portales clay loam, 1 to 3 percent slopes.

These soils have a high capacity to hold water and plant nutrients. If cultivated, they are susceptible to moderate water erosion and, except the Portales soil, to slight wind erosion. The Portales soil has moderate wind erosion.

Cotton is the main cash crop. Other cash crops that leave large amounts of residue on the soil and, therefore, help to reduce wind erosion are grain sorghum and small grain. The legumes, vetch, Austrian winter peas, and cowpeas, can be included in the cropping system. Alfalfa can be grown under irrigation.

Terraces and contour farming are needed on these soils. Farmers have learned that saving the moisture that falls on this land is absolutely necessary if they are to expect profitable yields.

Dryland.—Use a cropping system that, 2 years in 3, provides a crop that leaves large amounts of residue on the ground. This residue will provide organic matter that improves the soil and helps control erosion. During or following dry years, when little crop residue is produced, these soils should be deep chiseled or listed so that the ground is left cloddy and rough.

Much of the water that falls on these soils is lost during heavy rains because runoff is rapid and infiltration is slow. To obtain high yields, save as much water as possible. Terrace the soil and farm on the contour to conserve rainwater and to help control water erosion.

Irrigated.—Although these soils produce excellent yields under irrigation, they tend to form plowpans, or compact layers, if tilled when wet. Use alfalfa, Hubam clover, or other deep-rooted legumes in the cropping system so that the tilth and the supply of plant nutrients are maintained. Perennial grasses planted in a long rotation will also help keep these soils in good condition.

CAPABILITY UNIT IIIe-2 (IIf-2, IRRIGATED)

This group consists of reddish-brown to very dark grayish-brown fine sandy loams that are nearly level. These soils are less susceptible to wind erosion when they are irrigated than when they are dry-farmed. They are, therefore, in capability unit IIf-2 when they are irrigated. These soils are:

Amarillo fine sandy loam, 0 to 1 percent slopes.
 Arvana fine sandy loam, 0 to 1 percent slopes.
 Portales fine sandy loam, 0 to 1 percent slopes.
 Spur fine sandy loam.
 Zita fine sandy loam, 0 to 1 percent slopes.

These soils have a moderate capacity for holding available moisture and for retaining plant nutrients. They are susceptible to moderate wind erosion and to slight water erosion. The Portales soil will absorb water faster than the other soils.

The main cash crop grown on this soil is cotton. Grain sorghum and small grain are also grown as cash crops, and their residue can be left on the soil to help prevent wind erosion. Alfalfa, vetch, and cowpeas improve the soil and can also be harvested for hay.

Dryland.—Use a cropping system that, 2 years in 3, provides a crop that leaves a large amount of residue on the ground. If you stubble mulch the residue, this prevents its rapid decomposition and adds organic matter to the soil. In addition, the mulch prevents erosion by providing cover and keeping the soil rough. During or following years of low rainfall, when there is not enough cover to prevent soil blowing, chisel or list the soil so that it is cloddy and rough. A legume in the cropping system helps maintain the nitrogen needed by plants. Conserve moisture and prevent water erosion by terracing and contouring long slopes.

Irrigated.—If the soils in this group are irrigated, they need management in addition to that suggested for dryland farming. Fertilize according to the results of soil tests and the needs of crops. Local farmers have learned that yields on these soils decline after 3 or 4 years of use unless nitrogen and phosphate are added.

CAPABILITY UNIT IIIe-3

In this group are reddish-brown to grayish-brown fine sandy loams that are gently sloping. They are:

Amarillo fine sandy loam, 1 to 3 percent slopes.
 Arvana fine sandy loam, 1 to 3 percent slopes.
 Portales fine sandy loam, 1 to 3 percent slopes.

These soils are susceptible to moderate wind erosion and water erosion if they are cultivated. Their capacity to hold available moisture and plant nutrients is moderate. The Portales soil takes in water faster than the other soils in this group.

The main cash crop is cotton. Grain sorghum and small grain are also cash crops, and they supply large amounts of residue that help control erosion. Alfalfa, vetch, Austrian winter peas, and cowpeas improve the soil and furnish residue that helps prevent soil blowing. They also can be harvested for hay.

Dryland.—Use a cropping system that, 2 years in 3, provides a crop that leaves a large amount of residue on the soil. This residue maintains or increases the organic matter. Stubble mulch the residue to prevent it from decomposing rapidly and to help reduce wind erosion by covering the surface and keeping it rough. During or following dry years, when the soil is sparsely covered, chisel or list these soils so that the ground is left cloddy and rough and soil blowing is controlled. A legume in the cropping system will help supply nitrogen for crops that follow the legume. If cotton or other clean-tilled crops are grown, they must be grown on terraces so that moisture is conserved and erosion is controlled.

Irrigated.—In addition to the management suggested for dryland farming, these soils need to be fertilized if they are irrigated. Have your soils analyzed to determine the amount of fertilizer needed for the economical production of crops. Local farmers have learned that unless nitrogen and phosphate are added to irrigated areas, these soils decline in yields after 3 or 4 years of irrigation.

CAPABILITY UNIT IVe-1 (IIIe-4, IRRIGATED)

This group consists of light-gray to light brownish-gray, moderately deep to deep fine sandy loams that are nearly level or gently sloping. They are:

Arch fine sandy loam, 0 to 1 percent slopes.
 Drake fine sandy loam, 1 to 3 percent slopes.

These soils contain a large amount of lime. The lime slows the release of plant nutrients and frequently causes the leaves of sorghum to turn yellow. The Arch soil has a slight water erosion hazard, and the Drake soil has a moderate water erosion hazard. Both soils are highly susceptible to wind erosion.

The principal crops are grain sorghum, sudangrass, and small grain. Under irrigation, cotton and alfalfa are sometimes grown.

Dryland.—The cropping system should provide each year a close-growing crop that leaves large amounts of residue. To prevent wind erosion, stubble mulch the residue.

Irrigated.—If these soils are irrigated, you may grow cotton or some other clean-tilled crop 1 year in 3. Leave enough stubble to prevent soil blowing. Alfalfa produces fair yields but needs frequent watering. Because these soils are high in lime, fertilizers should be banded so that the roots of plants can get some of the phosphate.

CAPABILITY UNIT IVe-2

Bippus clay loam, 3 to 5 percent slopes, is the only soil in this unit. This soil is light-brown, moderately deep, moderately permeable clay loam.

All of this soil is in range and probably ought to remain in range. It would be highly susceptible to water erosion if it were cultivated and would need to be protected against runoff from adjacent, steeper soils. Each year it would need a closely spaced crop that leaves a large amount of residue, or it would have to be kept in perennial grass.

CAPABILITY UNIT IVe-3 (IIIe-5, IRRIGATED)

In this group are deep, light-colored, moderately permeable sandy soils that are level to gently sloping. They are:

Amarillo loamy fine sand, 0 to 3 percent slopes.
 Arch loamy fine sand, 0 to 3 percent slopes, overblown.
 Arvana loamy fine sand, 0 to 3 percent slopes.
 Brownfield fine sand, thin surface, 0 to 3 percent slopes.

These soils are highly susceptible to wind erosion if they are cultivated. They have low natural fertility. The sandy surface soil has a low capacity for holding available water and plant nutrients. Plant growth, when these soils are irrigated, is more affected by low fertility than it is on the less sandy soils.

If these soils are fertilized and protected against wind erosion, they can be used for cultivated crops, but they are best suited to perennial vegetation. Grain sorghum, sudangrass, and small grain are the main crops. Some cotton is grown under dryland farming, but this crop leaves the soil without cover much of the time. Under irrigation, alfalfa, Madrid or Hubam sweetclover, or other deep-rooted legumes are grown successfully. Vetch and cowpeas can be included in the cropping system to improve the soil.

Dryland.—A drilled or close-sown crop that leaves a large amount of residue should be grown each year in the cropping system. This crop provides enough residue to prevent soil blowing if the residue is stubble mulched. Emergency tilling is more effective in preventing wind erosion if the soil has been deep plowed and the content of clay in the surface soil increased. You can help maintain the supply of nitrogen by planting cowpeas and mung beans intersown with grain sorghum or vetch interplanted with small grain.

Irrigated.—Sprinkler irrigation is the only type of irrigation that is suited to these soils. If these soils are irrigated, a more intensive cropping system can be used. Farmers have learned that they can grow cotton or clean-tilled crops about one-third of the time and still control erosion. To maintain productivity under irrigation, however, add commercial fertilizer.

CAPABILITY UNIT IVc-4 (IIIe-6, IRRIGATED)

This group consists of shallow, reddish-brown to brown clay loams and fine sandy loams that are level or nearly level. They are:

- Arvana fine sandy loam, shallow, 0 to 3 percent slopes.
- Mansker clay loam, 0 to 1 percent slopes.
- Mansker clay loam, 1 to 3 percent slopes.
- Mansker fine sandy loam, 0 to 1 percent slopes.
- Mansker fine sandy loam, 1 to 3 percent slopes.

Because these soils are shallow, they have a low capacity for holding moisture and plant nutrients. They are difficult to terrace so that water erosion is controlled. Except for the Mansker clay loams, which have slight wind erosion, these soils are susceptible to moderate wind erosion. They are often droughty and leave little residue that can be used to control soil blowing.

These soils are best suited to permanent vegetation, but grain sorghum, sudangrass, and small grain are grown. Suitable legumes are cowpeas, guar (cluster bean), and Austrian winter peas. Some cotton is grown under irrigation.

Dryland.—Use a cropping system that provides only closely spaced crops that leave large amounts of residue. The residue should be stubble mulched for protection against the wind.

Irrigated.—On irrigated areas a more intensive cropping system can be used than on dry-farmed areas. You can plant cotton or another clean-tilled crop and still

maintain the soil and protect it against erosion. Irrigation is costly on these soils because they need small, frequent waterings.

CAPABILITY UNIT IVw-1

Randall fine sandy loam, overblown, is the only soil in this unit. It is a dark-colored soil that has an accumulation of fine sandy loam on the surface.

This soil is often flooded by runoff from soils on higher elevations. It is only moderately susceptible to erosion, but the frequent flooding limits its use. The areas of this soil are so small in most places that treatment different from that applied to adjoining areas is impractical.

CAPABILITY UNIT VIe-1 (IVe-5, IRRIGATED)

In this group are light-brown to brownish-gray soils that have short, steep slopes. They are:

- Drake soils, 3 to 5 percent slopes.
- Mansker clay loam, 3 to 5 percent slopes.
- Mansker fine sandy loam, 3 to 5 percent slopes.

These soils are highly susceptible to water erosion if they are cultivated. Native vegetation is their best use. If they are cultivated, reestablish the native grasses or plant imported perennial grasses. On irrigated areas, plant closely spaced crops that have large amounts of residue or sow alfalfa and perennial grasses.

CAPABILITY UNIT VIe-2 (IVe-6, IRRIGATED)

This group consists of light-colored, deep fine sands that are nearly level or gently sloping. They are:

- Brownfield fine sand, thick surface, 0 to 3 percent slopes.
- Brownfield fine sand, 0 to 3 percent slopes, eroded.
- Vona loamy fine sand, 0 to 3 percent slopes.

These soils are very susceptible to wind erosion. Their capacity to hold water and plant nutrients is low. Because of the thick, sandy surface soil, deep plowing to increase the clay content in the surface soil is not practical.

These soils are not suited to cultivated crops under dryland farming, but they are well suited to tall native grasses. Under irrigation, they produce limited yields of grain sorghum, small grain, and various close-sown perennial grasses.

Irrigated.—Sprinkler irrigation is the only type that can be used on these soils. If these soils are cultivated, close-spaced crops that have large amounts of residue ought to be grown each year and the stubble left to control wind erosion. Fertilizer is needed to maintain production.

CAPABILITY UNIT VIe-3

In this group are very shallow, nearly level to sloping soils. They are:

- Kimbrough soils, 1 to 5 percent slopes.
- Vernon soils, 1 to 8 percent slopes.

Because they are very shallow, these soils are not suited to cultivation. They have little native vegetation. Even when used for range, they need careful management to prevent erosion. Read the subsection, Range Management, for more information on the use and management of these soils.

CAPABILITY UNIT VIw-1

Randall clay is the only soil in this unit. This dark-colored, very heavy, poorly drained soil is in the playa beds.

This soil is frequently flooded by runoff from soils at higher elevations. Although it is only slightly susceptible to erosion, the danger of frequent flooding limits its use. Many of the small, shallow lakes are farmed during long, dry periods.

CAPABILITY UNIT VIIe-1

Tivoli fine sand is the only soil in this unit. This deep, light-colored, extremely sandy soil is often called sandhills. Because this soil has no runoff, much water is available for plants and tall native grasses grow. This soil is highly susceptible to wind erosion and is not suited to cultivation. Read the subsection, Range Management, for information on use and management.

CAPABILITY UNIT VIIe-2

Potter soils, 8 to 30 percent slopes, are the only soils in this unit. These grayish-brown soils are very steep and very shallow. They are not suited to cultivation. Although they have a fair vegetative cover, they need careful management to prevent water erosion. For information regarding their use for range, read the subsection, Range Management.

CAPABILITY UNIT VIIs-1

Stony rough land, Potter material, is the only land in this unit. This land is stony, rough, and steeply sloping and occurs mostly on the caprock escarpment. The small amount of soil that has developed is generally in pockets.

Because this land has large boulders, steep slopes, and cliffs, cattle and sheep graze with difficulty. The land is suitable for very limited grazing or for wildlife habitats. It seems to be a perfect habitat for the diamond-back rattlesnake.

Estimated Yields

The yields of a soil indicate what kind of management the soil has had. If a soil consistently has had high yields, probably the soil has been managed well. In Dawson County, the farmers manage their soils at different levels of management. Consequently, yields on the same kind of soil vary on different farms according to the level of management practiced.

In table 4, shown on the following page, are estimated yields of cotton and grain sorghum on soils under low-level and high-level management. Yields are given for dryland and irrigated farming for soils that are commonly cropped, if both methods are used on a particular soil. If only one method is practical, yields under this method are given. Not included in table 4 are soils that are used only for range. Many crops other than cotton and grain sorghum are grown in Dawson County, but they are grown in small acreages. Reliable yield data that cover a long period cannot be obtained for these crops.

The following describes low-level and high-level management under dryland and irrigated farming:

Low-level management—

Dryland:

1. Water is not properly conserved.
2. Soil-improving crops are not used in rotation.
3. Tillage alone is used to control wind erosion.

Irrigated:

1. Water is not saved.
2. Crop residue is turned under.
3. Irrigation is erratic.
4. Fertilization is haphazard or not used.

High-level management—

Dryland:

1. Water falling on land is saved.
2. Soil-improving and high-residue crops are used in the crop rotation.
3. Residue is used to help control wind erosion.

Irrigated:

1. Rainfall is saved and crops are watered according to need.
2. Fertilizer is used according to crop needs and the results of soil analyses.
3. Crop residue is used to help control wind and water erosion.
4. Soil-improving and high-residue crops are used in the rotation.

Practically all farmers in the county use a high level of insect and weed control. As a rule, the farmers that practice the best general management get the best results in their control of insects and weeds.

Practices of Soil Management

The hazards that management in Dawson County aims to overcome are mainly the result of low rainfall, high winds, and a short growing season. The purposes of the management are to offset these hazards by conserving rainfall, protecting the soil, improving its physical condition, and maintaining its productivity.

TABLE 4.—*Estimated average yields of irrigated and dryland cotton and grain sorghum under low-level and high-level management on soils commonly cultivated in Dawson County, Tex.*

Soil	Low-level management				High-level management			
	Cotton lint		Grain sorghum		Cotton lint		Grain sorghum	
	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated
Amarillo fine sandy loam, 0 to 1 percent slopes.....	<i>Lb. per acre</i> 170	<i>Lb. per acre</i> 530	<i>Lb. per acre</i> 850	<i>Lb. per acre</i> 2, 100	<i>Lb. per acre</i> 225	<i>Lb. per acre</i> 820	<i>Lb. per acre</i> 1, 200	<i>Lb. per acre</i> 4, 000
Amarillo fine sandy loam, 1 to 3 percent slopes.....	140	500	700	1, 700	210	750	1, 000	3, 500
Amarillo loamy fine sand, 0 to 3 percent slopes.....	150	550	700	1, 500	(¹)	750	1, 000	3, 500
Amarillo sandy clay loam, 0 to 1 percent slopes.....	150	500	725	2, 000	210	710	1, 050	4, 500
Amarillo sandy clay loam, 1 to 3 percent slopes.....	140	475	700	1, 700	200	675	975	4, 000
Arch fine sandy loam, 0 to 1 percent slopes.....	70	200	500	1, 300	(¹)	300	700	2, 500
Arch loamy fine sand, 0 to 3 percent slopes, overblown.....	100	500	700	1, 500	(¹)	700	950	3, 300
Arvana fine sandy loam, 1 to 3 percent slopes.....	120	400	700	1, 500	200	700	950	3, 000
Arvana fine sandy loam, 0 to 1 percent slopes.....	150	475	850	2, 100	220	750	1, 150	3, 300
Arvana fine sandy loam, shallow, 0 to 3 percent slopes.....	55	200	450	1, 200	(¹)	220	600	2, 200
Arvana loamy fine sand, 0 to 3 percent slopes.....	140	450	650	1, 500	(¹)	700	900	3, 000
Brownfield fine sand, thin surface, 0 to 3 percent slopes.....	120	400	650	1, 500	(¹)	600	900	3, 000
Brownfield fine sand, thick surface, 0 to 3 percent slopes.....	75	350	600	1, 300	(¹)	(¹)	(¹)	2, 500
Brownfield fine sand, 0 to 3 percent slopes, eroded.....			450	1, 200	(¹)	(¹)	(¹)	2, 000
Drake fine sandy loam, 1 to 3 percent slopes.....	60	180	600	1, 200	(¹)	300	800	2, 500
Drake soils, 3 to 5 percent slopes.....	50	130	400	1, 000	(¹)	(¹)	(¹)	2, 000
Mansker fine sandy loam, 1 to 3 percent slopes.....	65	200	450	1, 200	(¹)	220	700	2, 400
Mansker fine sandy loam, 0 to 1 percent slopes.....	75	220	500	1, 300	(¹)	250	750	2, 500
Mansker fine sandy loam, 3 to 5 percent slopes.....	50	170	400	1, 000	(¹)	(¹)	(¹)	2, 000
Mansker clay loam, 0 to 1 percent slopes.....	80	220	500	1, 400	(¹)	280	750	2, 500
Mansker clay loam, 1 to 3 percent slopes.....	70	200	450	1, 300	(¹)	260	700	2, 400
Mansker clay loam, 3 to 5 percent slopes.....					(¹)	(¹)	(¹)	2, 000
Portales clay loam, 0 to 1 percent slopes.....	125	500	650	2, 000	170	700	1, 050	4, 300
Portales clay loam, 1 to 3 percent slopes.....	115	475	600	1, 700	160	650	1, 000	4, 000
Portales fine sandy loam, 0 to 1 percent slopes.....	140	500	725	1, 800	200	710	1, 100	4, 000
Portales fine sandy loam, 1 to 3 percent slopes.....	100	450	575	1, 600	190	700	900	3, 600
Randall fine sandy loam, overblown.....	150	550	700	1, 500	(¹)	750	1, 000	3, 000
Spur clay loam.....	160	600	750	2, 400	220	700	1, 100	4, 000
Spur fine sandy loam.....	150	550	700	2, 200	210	750	1, 050	3, 800
Vona loamy fine sand, 0 to 3 percent slopes.....	80	350	500	1, 300	(¹)	(¹)	700	2, 800
Zita fine sandy loam, 0 to 1 percent slopes.....	180	600	900	2, 000	230	850	1, 200	4, 000

¹ Crop not recommended to be grown; soil has severe limitations or erosion hazards.

Control of wind erosion

The greatest hazard that affects soil management in the county is wind erosion, which is the result of the movement of the soil by wind (fig. 7, 8). The three kinds of soil movement caused by wind are floating, bouncing, and creeping. The clay and silt particles of the soil float, or move in the air, during a sandstorm or wind-storm. Particles the size of very fine sand to medium sand move in a series of short bounces. These particles strike larger particles that, in turn, creep along the surface. The particles that bounce may detach and lift clay and silt into the air. Materials that bounce or creep do

not move far. Dust that is suspended in the air, however, may move hundreds of miles.

A clod about the size of an alfalfa seed, or 0.84 millimeter ($\frac{1}{32}$ of an inch) in diameter, resists being moved by the wind. The sandy soils in Dawson County normally have 0 to 12 percent of their soil material in clods of 0.84 millimeter or larger. These clods tend to stay in place when the wind blows. The fine sandy loam soils are more resistant to the wind. Their soil material has 12 to 35 percent of the volume in clods 0.84 millimeter or larger. Table 5 gives, for selected soils, the percentage of soil material made up of clods larger than 0.84 millimeter in diameter.



Figure 7.—Very severe wind erosion as a result of misuse of Brownfield fine sand, 0 to 3 percent slopes, eroded.



Figure 8.—Amarillo sandy clay loam, 0 to 1 percent slopes, that has been very severely eroded by the wind.

Higher wind velocities are required to start erosion on a rough field than on a smooth one. The roughness of a field depends on the size, shape, and spacing of the clods, ripples, and ridges and on the height and density of the plant cover.

For a long time listing has been used to help control soil blowing. The effectiveness of listing depends largely on the amount of stubble left standing on the field, on the surface roughness made by the listing, and on the amount of clay and moisture the soil contains. The clay and moisture tend to increase cloddiness.

Residue left by crops helps control soil blowing by slowing down the wind at the surface of the soil. Standing stubble reduces the force of the wind more than flattened stubble, and closely spaced stubble more than the same amount of widely spaced stubble.

Table 5 gives information that is helpful in comparing the erodibility of selected soils in Dawson County. This table also lists the weight of residue per acre needed to control erosion. The texture of the 0-1 inch surface layer differs from the textural name of some of the soils in table 5 because this layer may contain overblown material.

The finer textured soils have a larger percentage of their soil material in clods than the coarser ones and, therefore, tend to have less wind erosion. The relative erodibility of the soils can also be studied by comparing the weight of the residue that is needed on an acre of soil to control erosion. Generally, more residue is needed on the coarser textured soils. Table 5 also shows that the maximum soil loss per acre is greater on the sands

TABLE 5.—Percentage of soil material in clods greater than 0.84 millimeter, weight of residue required to control wind erosion, and maximum soil loss per acre for selected soils on the high plains in Texas ¹

Soil type	Depth and thickness of layer	Texture (by field determination)	Clods greater than 0.84 mm.	Weight of residue required to control wind erosion ²	Maximum soil loss per acre, with minimum roughness and residue
	<i>Inches</i>		<i>Percent ³</i>	<i>Lb. per acre</i>	<i>Tons per acre</i>
Tivoli fine sand (one site)-----	0-1	Loamy fine sand-----	19.4	1,400	150
	1-6	Fine sand-----	4.6	3,000+	1,600
Brownfield fine sand, thick surface (average of three sites).	0-1	Loamy fine sand-----	19.0	1,400	150
	1-6	Fine sand-----	15.9	1,600	240
Brownfield fine sand, thin surface ⁴ (average of three sites).	0-1	Loamy fine sand-----	21.9	1,200	110
	1-14	Loamy fine sand-----	19.4	1,400	150
	14-21	Sandy clay loam-----	87.8	100	0
Portales fine sandy loam (average of two sites)-----	0-1	Fine sandy loam-----	31.7	780	40
	1-10	Fine sandy loam-----	47.2	440	12
Amarillo fine sandy loam (average of four sites)-----	0-1	Fine sandy loam-----	41.0	600	20
	1-10	Fine sandy loam-----	56.3	370	6

¹ COOVER, JAMES R., AND MOLDENHAUER, WILLIAM C., SOME CRITERIA FOR CAPABILITY CLASSIFICATION OF THE SOILS OF THE SOUTHERN GREAT PLAINS OF TEXAS. Soil Sci. Amer. Proc. 21:6, 1957.

² On land untilled since last crop was grown.

³ Percentage of soil material in clods greater than 0.84 mm. across.

⁴ Called Brownfield loamy fine sand in the paper cited.



Figure 9.—Stubble-mulching equipment in operation.

than on the fine sandy loams when the minimum amount of protection is given by surface roughness and residue.

Stubble mulching

Stubble mulching is mainly a protective practice. It is a way of plowing, planting, cultivating, and harvesting crops so that the amount of crop residue needed to protect the soil is left on the ground throughout the year. Figure 9 shows a field of residue on which grain sorghum stubble is being mulched.

Crops that normally have enough residue to protect the soil are grain and forage sorghum, small grain, perennial grass, and legumes such as alfalfa, vetch, winter peas, and sweetclover. If these crops are stubble mulched, they (1) provide cover on the soil when crops are not grown, (2) conserve moisture by increasing the intake of water and reducing evaporation, and (3) help maintain the content of organic matter. Figure 10 shows a field that has been stubble mulched to help control erosion. If there is not enough stubble mulch to control erosion, the soil should be tilled to make it cloddier and rougher. The stubble is generally scarce during and following periods of low rainfall and on the sandier soils.

Stripcropping

Stripcropping is a protective practice in which crops are grown in alternate bands. In one band are tall, leafy crops that leave much residue. The companion crop in the alternate band leaves little residue. Crops suitable for the protective strips are grain and forage sorghum, sudan, and tall perennial grasses. The protective strips protect the companion crop from the sand-blasting wind and protect the soil after the companion crop is harvested.

A common practice in Dawson County is to plant 4-row bands of sudan and alternate 8-row bands of cotton. On highly erodible soils that are used for cotton, list or till soon after harvest. This prevents local soil movement and the accumulation of soil in the strips of protective crops.

Conservation crop rotations

Crop rotations are used in Dawson County as a combination practice that protects the soil, improves its physical condition, and maintains its fertility. In the

rotation or sequence, the soil-improving crops offset the harmful effects of the soil-depleting crops. The cropping system ought to (1) maintain or increase the productivity of the soil; (2) provide enough growing or dead cover to protect the soil from wind erosion; and (3) keep the soil in good physical condition.

Dryland farming.—Crop rotations for dryland farming are generally based on cotton and grain sorghum. Cotton, the soil-depleting crop, returns little residue to the soil. It is grown in rotation with grain sorghum, which has much residue. This residue ought to be managed so that it protects and improves the soil. How often the grain sorghum is grown depends on the danger of wind erosion.

Farmers in Dawson County have learned that plenty of residue is maintained on soils that have only a slight danger of wind erosion if cotton is grown for 1 year and followed by 1 year of grain sorghum. Soils that have a moderate danger of wind erosion need 1 year of cotton followed by 2 years of grain sorghum. Those highly susceptible to wind erosion need grain sorghum grown continuously in closely spaced rows. According to Earl Burnett, Superintendent of the United States Big Spring Field Station, Big Spring, Tex., research at the station indicates that dual-purpose grain sorghums, such as early Hegari, ought to be used to provide adequate amounts of residue after grain harvest. These sorghums will provide one-third or more residue than hybrid varieties of grain sorghum.

Some farmers plant small grain (fig. 11), millet, sudan, or perennial grasses to obtain the residue needed. Cowpeas, mungbeans, guar, and other summer legumes have caused an increase in yields of crops that follow. These legumes, however, leave little residue that can be managed to help control wind erosion.

Irrigated farming.—The rotations given for dryland farming and the following rotations are suited to irrigated farming:

On soils that have slight danger of wind erosion—

1. Cotton; 3 years of alfalfa; cotton.
2. Cotton overseeded with Madrid clover; grain sorghum.

On soils that have moderate to high danger of wind erosion—

1. Cotton; 3 years of alfalfa; cotton; grain sorghum.



Figure 10.—Mulching stubble to help control erosion.

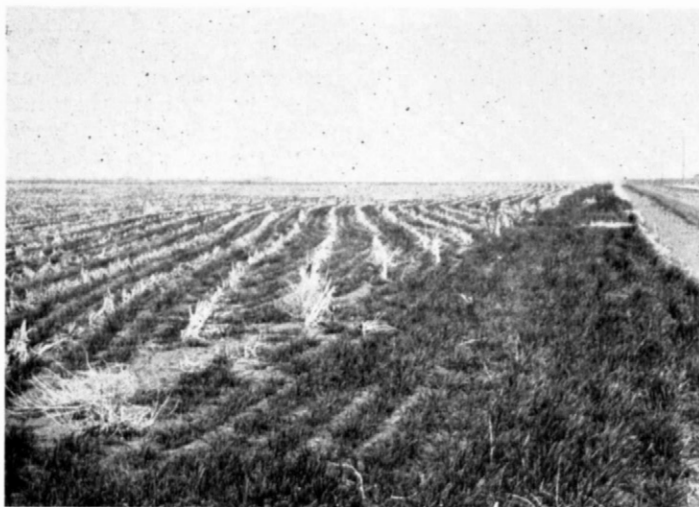


Figure 11.—Small grain overseeded in sorghum stubble as part of a conservation crop rotation.

2. Cotton; Madrid clover; cotton; grain sorghum or sudangrass.

On soils that have very high danger of wind erosion, in rows less than 24 inches apart—

1. 3 years of alfalfa; 3 years of grain sorghum.
2. 3 years of perennial grass; 3 years of grain sorghum interplanted with mungbeans or cowpeas.

Farming on terraces and on the contour

These methods of farming are protective. They are used to hold water where it falls so that moisture is conserved and water erosion is prevented (fig. 12). In Dawson County, the conservation of moisture is particularly important on sandy clay loams and clay loams. Farmers have reported several instances in which enough moisture has been saved on terraces during one heavy rain in spring to increase the yield of cotton one-half bale per acre over the yield of adjoining land that was not terraced.

If your land needs terracing, the engineers of the Soil Conservation Service and other qualified specialists will help you plan a system.



Figure 12.—Terraces and contoured land will control water erosion and conserve water for plant use.

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Deep plowing

Deep plowing is used to help protect the soil from erosion. It is widely used on highly erodible soils that have a surface soil of fine sand or loamy fine sand. By deep plowing, 3 to 6 inches of the sandy clay loam subsoil is brought to the surface in the furrow slice (fig. 13). When this finer material is mixed with the sandy surface soil, the texture of the plow layer is fine sandy loam. If the field is tilled after deep plowing, the soil then can be roughened and made to form stable clods that are not blown away. If sandy erodible soils are dry-farmed, it is almost impossible to grow crops that leave enough residue to control soil blowing. After the soils are deep plowed, use a combination of crop residue, cloddiness, and roughness to control wind erosion. Deep plowing alone is not enough.

After deep plowing, the stability of the surface must be maintained. If there is drifting on the surface, a deep mantle of sand may form. Then you may not be able to plow deep enough in the future to reach the sandy clay loam subsoil.



Figure 13.—A deep plowing rig that plows to a depth of 18 to 24 inches and brings 4 to 6 inches of the sandy clay loam subsoil to the surface.

Conservation irrigation

A good system for conservation irrigation:

1. Maintains or increases soil productivity.
2. Controls erosion.
3. Uses rainfall and irrigation water efficiently.
4. Prevents excess leaching of plant nutrients.
5. Disposes of excess water without causing erosion.
6. Prevents waterlogging and the accumulation of harmful salts.

Most important is maintaining or increasing soil productivity. Unless the soil is managed well, the best system for control and distribution of water will not be successful.

Among the things that must be considered in designing a system for conservation irrigation are:

1. The quality and quantity of available water.
2. How fast the soil will take water and how much it will hold.
3. The water needs for crops grown.
4. The topography of the land irrigated.

Engineers in the Soil Conservation Service will help you design a conservation irrigation system that is suited to your soil, water supply, and selected crops.

Use of commercial fertilizer

Commercial fertilizer was not used in Dawson County until 1952. Farmers believed that fertilization under dryland farming did not pay. The scarcity of moisture was the main limitation to be overcome. But as irrigation spread, farmers noticed that yields declined after irrigated farms were cropped 3 or 4 years. In 1952, about 5,000 acres of irrigated cotton was fertilized. Results were favorable, and by 1957 the area irrigated increased to about 30,000 acres.

Experience gained from fertilization in the county indicates that 200 pounds of high analysis fertilizer can be expected to increase the yield of cotton $\frac{1}{4}$ to $\frac{1}{2}$ bale per acre. Most soils need additions of nitrogen and phosphate but do not need potash. Although additions of potash do not increase the yield of seed cotton, apparently they do increase the percentage of lint in the yield and the length of the staple.

In 1954, tests were made at Lubbock on Amarillo fine sandy loams that had produced 5,000 pounds of grain sorghum per acre the year before. Yields were increased 1,907 pounds after the addition of 40 pounds of nitrogen and 80 pounds of phosphoric acid. Tests on land that had not been heavily cropped indicate that the increase in yields does not pay for the increased cost of fertilization.

Little evidence supports the use of commercial fertilizers on dry-farmed crops, although their use is a possibility.

Range Management ¹

About 66,860 acres in Dawson County, or 11 percent of the agricultural land, is used for grazing. The soils used for grazing, as a rule, are not suitable for cultivation. They will, however, produce excellent stands of grasses year after year if they are managed properly. The purpose of this subsection is to furnish information on managing range so that the range will produce vigorous stands of desirable grasses. You can get additional information on the management of your range from local representatives of the Soil Conservation Service serving the Dawson County Soil Conservation District.

This subsection consists of two main parts. In the first part, the soils of the county are grouped in range sites according to soil features that, in turn, influenced the kinds of plants that originally grew on the soils. In the second part, general principles of range management are discussed.

Range sites

A range site is an area having a distinctive combination of climate, soils, topography, drainage, and, consequently, a definite combination of plants and potential for grazing. The combination of plants that originally grew on the site is the most productive that will grow there.

This combination is called climax vegetation. It provides the best protection against erosion.

Any range that has 75 percent or more of its climax vegetation is in *excellent* condition. A range that has 50 to 75 percent of its climax vegetation is in *good* condition; one that has 25 to 50 percent is in *fair* condition; and one having less than 25 percent is in *poor* condition.

Four or five kinds of grasses generally are dominant in climax vegetation. Probably other grasses were present, but these four or five made up more than 75 percent of the total forage that could be grazed. If the dominant plants in the climax vegetation make up 75 percent of the forage that can be grazed on a particular range site, the range site is probably producing almost its maximum yield of forage.

If your range is not producing its climax vegetation, the proportion of the dominant plants in the climax vegetation should be increased. It is necessary, therefore, for you to determine the kinds of plants that are dominant in the climax vegetation and then to manage the range so that the proportion of these plants in the total vegetation will be increased.

To assist you in determining the dominant plants in the climax vegetation, the soils of the county have been placed in range sites and the plants that were dominant in the climax vegetation are given in order of their proportion of the total vegetation. Suppose your range is on a range site that had side-oats grama, blue grama, tobosagrass, and buffalograss as the dominant plants in the climax vegetation. Estimate the percentage of the total vegetation that is made up by the side-oats grama, blue grama, tobosagrass, and buffalograss now growing on your range. If these plants now make up a high percentage of the total vegetation, your range is in good condition. Local specialists of the Soil Conservation Service will help you evaluate the condition of your range and will suggest ways of improving it.

RANGE SITES ON THE HIGH PLAINS

1. **BOTTOM LAND, HIGH PLAINS:** This range site is along streams. It consists of the following loamy soils that regularly receive water from soils at higher elevations:

- Spur clay loam.
- Spur fine sandy loam.

The dominant grasses in the climax vegetation are side-oats grama, white tridens, cane bluestem, silver bluestem, Arizona cottontop, vine mesquite, and blue grama.

2. **SAND HILL, HIGH PLAINS:** This range site consists of Tivoli fine sand—a deep, loose, rather coarse-textured soil that has abrupt slopes. The grasses dominant in the climax vegetation are sand bluestem, little bluestem, spike dropseed, giant dropseed, Havard panic, and giant sandreed.

3. **SANDY LAND, HIGH PLAINS:** This range site consists of the following loose, gently rolling, coarse-textured soils:

- Amarillo loamy fine sand, 0 to 3 percent slopes.
- Arch loamy fine sand, 0 to 3 percent slopes, overblown.
- Arvana loamy fine sand, 0 to 3 percent slopes.
- Brownfield fine sand, thin surface, 0 to 3 percent slopes.

¹ This subsection was written by AL WILHITE, range conservationist, Soil Conservation Service.

Brownfield fine sand, 0 to 3 percent slopes, eroded.
Brownfield fine sand, thick surface, 0 to 3 percent slopes.
Vona loamy fine sand, 0 to 3 percent slopes.

The grasses dominant in the climax vegetation are little bluestem, side-oats grama, mesa dropseed, spike dropseed, Arizona cottontop, black grama, and hooded windmillgrass.

4. **MIXED LAND, HIGH PLAINS:** This range site consists of nearly level, sandy soils that have moderate wind erosion:

Amarillo fine sandy loam, 0 to 1 percent slopes.
Amarillo fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, shallow, 0 to 3 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

The dominant grasses in the climax vegetation are side-oats grama, blue grama, Arizona cottontop, cane bluestem, silver bluestem, black grama, and little bluestem.

5. **HIGH LIME, HIGH PLAINS:** The soils on this range site are sandy loams and clay loams that contain a large amount of lime:

Arch fine sandy loam, 0 to 1 percent slopes.
Drake fine sandy loam, 1 to 3 percent slopes.
Drake soils, 3 to 5 percent slopes.
Mansker clay loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 0 to 1 percent slopes.
Portales fine sandy loam, 1 to 3 percent slopes.
Portales clay loam, 0 to 1 percent slopes.
Portales clay loam, 1 to 3 percent slopes.

The dominant grasses in the climax vegetation are side-oats grama, blue grama, vine mesquite, cane bluestem, silver bluestem, plains bristlegrass, and Arizona cottontop.

6. **DEEP HARD LAND, HIGH PLAINS:** This range site consists of deep, fine-textured, moderately permeable soils:

Amarillo sandy clay loam, 0 to 1 percent slopes.
Amarillo sandy clay loam, 1 to 3 percent slopes.

The dominant grasses in the climax vegetation are side-oats grama, blue grama, tobosagrass, and buffalograss.

7. **SHALLOW LAND, HIGH PLAINS:** In this range site are soils that are less than 20 inches deep:

Kimbrough soils, 1 to 5 percent slopes.
Mansker clay loam, 1 to 3 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.
Mansker fine sandy loam, 3 to 5 percent slopes.
Potter soils, 8 to 30 percent slopes.

The grasses dominant in the climax vegetation are side-oats grama, blue grama, black grama, buffalograss, and tobosagrass.

8. **ROUGH BROKEN LAND, HIGH PLAINS:** This range site consists of Stony rough land, Potter material—a poorly developed, mixed-land soil derived from Potter material. The grasses dominant in the climax vegetation are side-oats grama, cane bluestem, silver bluestem, blue grama, and black grama.

RANGE SITES ON THE ROLLING PLAINS

1. **BOTTOM LAND, ROLLING PLAINS:** This range site consists of Spur clay loam—a soil that regularly receives runoff from adjacent, higher soils. The grasses dominant in the climax vegetation are sand bluestem, side-oats grama, white tridens, vine mesquite, and blue grama.

2. **DEEP HARD LAND, ROLLING PLAINS:** This range site consists of Abilene clay loam, 0 to 1 percent slopes—a deep, slowly permeable, fine-textured soil. The grasses dominant in the climax vegetation are side-oats grama, blue grama, buffalograss, and tobosagrass.

3. **SHALLOW LAND, ROLLING PLAINS:** On this range site are fine-textured, moderately permeable soils that are less than 20 inches deep:

Mansker clay loam, 1 to 3 percent slopes.
Mansker clay loam, 3 to 5 percent slopes.
Potter soils, 8 to 30 percent slopes.

The dominant grasses in the climax vegetation are side-oats grama, cane bluestem, silver bluestem, blue grama, tobosagrass, and buffalograss.

4. **SHALLOW HARD LAND, ROLLING PLAINS:** This range site consists of Vernon soils, 1 to 8 percent slopes. These soils are shallow, fine textured, and slowly permeable. The dominant grasses in the climax vegetation are blue grama, vine mesquite, tobosagrass, and buffalograss.

5. **ROUGH BREAKS, ROLLING PLAINS:** This range site consists of Stony rough land, Potter material—a poorly developed, mixed-land soil derived from Potter material. The dominant grasses in the climax vegetation are little bluestem, side-oats grama, blue grama, hairy grama, black grama, and slim tridens.

6. **HARD LAND SLOPES, ROLLING PLAINS:** On this range site are dry, fine-textured, moderately permeable, upland soils:

Bippus clay loam, 0 to 1 percent slopes.
Bippus clay loam, 1 to 3 percent slopes.
Bippus clay loam, 3 to 5 percent slopes.
Miles sandy clay loam, 0 to 1 percent slopes.
Miles sandy clay loam, 1 to 3 percent slopes.

The dominant grasses in the climax vegetation are cane bluestem, silver bluestem, blue grama, side-oats grama, and Arizona cottontop.

Principles of range management

Native range grasses are a crop, and, like any other, they respond to management. To use your range efficiently so that a large part of the total vegetation consists of the dominant plants in the climax vegetation, consider the following: (1) Number of livestock on a range; (2) distribution of grazing; (3) season of use; and (4) kinds of livestock.

NUMBER OF LIVESTOCK ON A RANGE

If a range is to be improved or kept in excellent condition, the number of livestock ought to be balanced against the amount of forage grown. A range that is in proper balance will continue to have maximum forage.

The proper balance between the number of livestock and the forage grown can be determined by observing each pasture to see that the dominant plants in the climax vegetation are being grazed in a manner that will insure maximum production. No more than 50 percent, by weight, of a year's growth of key plants should be grazed on any site. This will be accomplished if at the end of the grazing season a stubble 7 to 10 inches high is left for tall grasses, 4 to 7 inches for mid grasses, and 2 to 3 inches for short grasses. If the proper balance

between livestock and forage is maintained, the forage left on the ground:

1. Serves as a mulch that assists the intake and storage of water and reduces the loss of moisture through evaporation.
2. Assists the roots in penetrating the soil and in reaching water that is not available to the roots of overgrazed grass.
3. Protects the soil against wind and water erosion.
4. Assists the grass in crowding out weeds.
5. Enables plant roots to store food, which is available for rapid, vigorous growth after droughts.
6. Provides a reserve of dry grass that might prevent the necessity of selling livestock at a loss.

DISTRIBUTION OF GRAZING

Some ranges in Dawson County are overgrazed in some places and undergrazed or not grazed at all in other places (fig. 14). Livestock can be made to graze in the places desired by the proper distribution of water and salt and by erection of fences in proper places.

The poor distribution of water is one of the main causes of uneven grazing. Water that livestock can drink ought to be well distributed on the range so that the animals can get a drink without walking very far. In Dawson County, do not make cattle walk more than 1½ miles in smooth country or 1 mile in rough or sandy country. Place salt lightly in many places on grazed areas where it can be reached from several directions.

Fences ought to be erected, if possible, between range sites. This is because the vegetation on different range sites differs, and the sites need different kinds of management. If two different range sites are within a single enclosure, it is difficult to keep the vegetation uniform because the two range sites generally produce different kinds of vegetation, which are grazed unevenly.

SEASON OF USE

The proper time for grazing is determined by the range site and the condition of the range. All range sites in Dawson County generally produce warm-season vegetation. The plants begin to grow in April and

continue to grow until the first frost. Forage production is highest in spring and early in summer.

Although most of the growth is during warm weather, the grasses cure well and furnish palatable and nutritious forage during winter. This is particularly true of the short and mid grasses. Because of this available dry forage, and because grasses in the lowlands grow a little in winter, the ranges in Dawson County are well suited to grazing throughout the year.

Defer the grazing on ranges that are in poor or fair condition from time to time so that the grasses can increase in vigor and density and establish new seedlings. Grazing on range sites in good and excellent condition generally needs to be deferred in fall. If a range has been damaged by overgrazing, drought, or fire, deferment of grazing will allow better grasses to seed and regain their vigor. Local representatives of the Soil Conservation Service will help you in determining the best time to use and the best time to rest the individual pastures.

KINDS OF LIVESTOCK

The animals grazed should suit the grass, the soils, and the climate of the area. Ranchers in Dawson County have learned that cattle are best suited. Sheep are not particularly suitable because their habits of close grazing and trailing encourage erosion.

Engineering Applications²

The information in the report can be used to:

1. Make soil and land use studies that will aid in selecting sites for industrial, business, residential, and recreational developments.
2. Make preliminary estimates of the engineering properties of soils in planning for the construction of farm ponds and irrigation systems and in planning soil and water conservation measures.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, and storage areas and in planning detailed investigations of selected locations.
4. Locate probable sources of sand, gravel, topsoil, and other construction material.
5. Correlate performance of engineering construction with soil mapping units and thus develop information useful in designing and maintaining structures.
6. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction in a particular area.

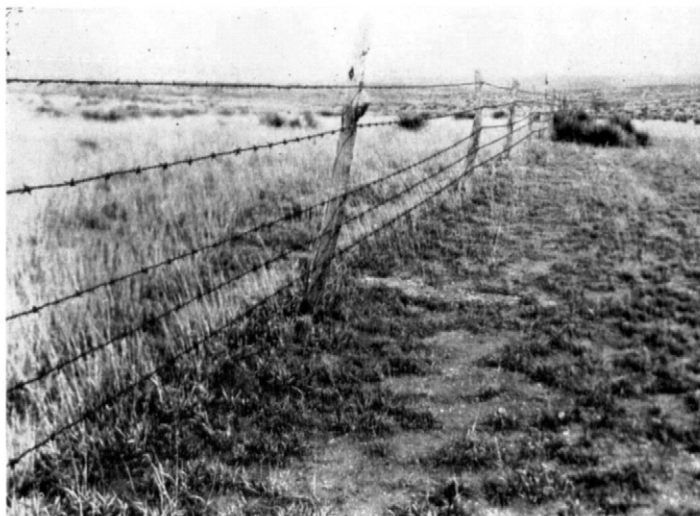


Figure 14.—Controlled grazing on left of fence; overgrazing on right of fence.

²This section was written by LEE H. WILLIAMSON, engineer, Soil Conservation Service, and HORACE E. MITCHELL, soil scientist, Soil Conservation Service.

This section and other parts of this report do not contain enough information to enable the engineer to omit sampling and testing the soils at the construction site and at other places where soil is taken for use in structures.

Soil Science Terminology

Some of the terms used by soil scientists may be unfamiliar to the engineer, and some words, such as soil, clay, silt, sand, aggregate, and granular structure, may have special meanings in soil science. These terms are defined as follows:

Soil: The natural medium for the growth of land plants on the surface of the earth; composed of organic and mineral materials.

Clay: A soil particle or size group of mineral particles less than 0.002 millimeter in diameter; a textural class that has soil material containing 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Silt: A soil particle ranging from 0.05 millimeter to 0.002 millimeter in diameter; a textural class that has soil material containing 80 percent or more silt and less than 12 percent clay.

Sand: A soil particle ranging from 2.0 millimeters to 0.05 millimeter in diameter; a textural class that has soil material containing 85 percent or more sand and not more than 10 percent of clay.

Aggregate: A cluster of primary soil particles held together by internal force to form a clod or fragment.

Granular structure: Individual grains grouped in spherical aggregates that have indistinct sides. Highly porous granules are commonly called crumbs.

Engineering Description of Soils

Table 6 gives an engineering description of the soils in Dawson County and an estimate of physical properties that are important in engineering.

The soil material in the horizons of a typical profile for each soil type is classed in three systems—USDA, Unified, and AASHO. The USDA system is the textural classification used by the Soil Conservation Service in soil surveys.

The Unified classification was developed at Vicksburg Waterways Experiment Station by the Corps of Engineers, U.S. Army. In this system soil material is put in 15 classes that are designated by pairs of letters. These classes range from GW, which consists of well-graded gravel, gravel and sand mixtures, and a little fine material, to Pt, which consists of peat and other highly organic soils.

Many highway engineers classify soil material according to the AASHO method. This method was adopted by the American Association of State Highway Officials. In this system, soil materials are classed in seven principal groups. The groups range from A-1, consisting of soils that have high bearing capacity, to A-7, consisting of clayey soils having low strength when wet.

Within each group, the relative engineering value of the soil material is indicated by a group index number. These numbers range from 0 for the best material to 20

for the poorest. The group index number is shown in parentheses following the soil group symbol (see table 8).

The classification by grain size in table 6 was determined from data provided by the Bureau of Public Roads. For all soils except the Abilene, the data used were those for soils in Lynn County that are similar to the soils in Dawson County. For the Abilene soils, data for the Abilene soils in Haskell County were used.

The values for permeability and for available water were compiled from the data in the work unit technical guide used by technicians in the county. Permeability is the rate, given in inches per hour in table 6, that water moves through a soil horizon. The available water is listed in inches per foot of depth. This is a measure of the water-holding capacity of a soil. A layer of Abilene clay loam, 1 foot thick, will hold 2.4 inches of water placed on the surface. If another 2.4 inches of water is added, another foot of soil will be wetted. A layer of Tivoli fine sand, 1 foot thick, will hold only 0.5 to 0.75 inch of water.

The dispersion and the shrink-swell potential were estimated by specialists familiar with the soils of the area. A dispersed soil usually runs together and becomes plastic when wet. It normally has low permeability, tends to have high bulk density, and forms hard lumps on drying.

The shrink-swell potential is an estimate of how much a soil shrinks and swells under extremes of dryness and wetness. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures.

The depth to the seasonably high water table is not given in table 6 because all soils in the county except the Spur soils have a very low water table. At times, the Spur soils have a high water table.

Engineering Interpretation of Soils

In table 7 are the results of evaluating the soils of the county from an engineering standpoint. This interpretation is based on the information in table 6, actual test data that was available, and knowledge of specialists. Also available was information from State highway engineers and personnel in construction companies.

All soils in the county are suitable for fill material if the material is properly placed and compacted. To make the best fill material, the sandy surface layer of some soils must be graded with the finer textured layers in the soil profile. The most difficult soils to place and compact are the sands that do not contain enough fine material for binding. The heavier red clays on the rolling plains are easily compacted, but they may be overcompacted. Overcompaction may cause an unstable fill and a corrugated and uneven surface.

All the soils in the county except the Spur soils are suited to winter grading. The Spur soils may have a high water table, but long periods of subfreezing weather are not likely to occur. None of the soils in the county are suitable as a source of sand and gravel.

In engineering construction in Dawson County, the bedrock under the soils is not likely to be reached. The large boulders in the stony, rough land are not so difficult to handle as bedrock.

TABLE 6.—*Engineering description of soils in Dawson*

Soil name	Soil description	Depth and thickness of horizons in typical profile	Classification		
			USDA	Unified ¹	AASHTO ²
Abilene clay loam, 0 to 1 percent slopes.	2½ to 3½ feet of slowly permeable, well-drained clay loam overlying outwash material of calcareous clays and sandy clays; along eastern edge of rolling plains.	Inches 0-8	Clay loam-----	CL-----	A-6-----
		8-24	Clay loam-----	CL-----	A-7-----
		24-42	Clay loam-----	CL-----	A-6-----
Amarillo fine sandy loam, 0 to 1 percent slopes.	8 to 14 inches of fine sandy loam overlying 24 to 40 inches of moderately permeable, well-drained sandy clay loam; on unconsolidated, moderately sandy, alluvial and eolian sediments; in southern part of high plains.	0-14	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
Amarillo fine sandy loam, 1 to 3 percent slopes.		14-44	Sandy clay loam.	SC or CL-----	A-6-----
		44-60	Sandy clay loam.	SC or CL-----	A-4 or A-6...
Amarillo loamy fine sand, 0 to 3 percent slopes.	8 to 14 inches of loamy fine sand overlying 18 to 40 inches of moderately permeable, well-drained sandy clay loam; on unconsolidated, moderately sandy, alluvial and eolian sediments; in southern part of high plains.	0-10	Loamy fine sand.	SM-----	A-2-----
		10-46	Sandy clay loam.	CL-----	A-4 or A-6...
		46-54	Sandy clay loam.	SC or CL-----	A-4 or A-6...
Amarillo sandy clay loam, 0 to 1 percent slopes.	6 to 12 inches of sandy clay loam overlying 24 to 36 inches of moderately permeable, well-drained clay loam.	0-8	Sandy clay loam.	CL-----	A-4 or A-6...
Amarillo sandy clay loam, 1 to 3 percent slopes.		8-56	Clay loam-----	CL-----	A-6-----
Arch fine sandy loam, 0 to 1 percent slopes.	8 to 14 inches of well-drained, strongly calcareous fine sandy loam; on chalky earth that consists of old alluvium or outwash; material apparently modified by calcium carbonate deposited by ground water; in broad valleys and on benches around intermittent lakes in southern part of high plains.	0-10	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
		10-26	Sandy clay loam and clay loam.	CL-----	A-6-----
		26-60	Sandy clay loam.	SC or CL-----	A-4 or A-6...
Arch loamy fine sand, 0 to 3 percent slopes, overblown.	14 to 22 inches of well-drained loamy fine sand; on chalky earth that consists of old alluvium or outwash; material apparently modified by calcium carbonate deposited by ground water; in broad valleys and on benches around intermittent lakes in southern part of high plains.	0-20	Loamy fine sand.	SM-----	A-2-----
		20-60	Sandy clay loam and fine sandy loam.	SC or CL-----	A-4 or A-6...
Arvana fine sandy loam, 1 to 3 percent slopes.	6 to 10 inches of fine sandy loam overlying 10 to 30 inches of moderately permeable, well-drained sandy clay loam; on a thin, sandy, eolian mantle deposited over indurated caliche.	0-6	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
Arvana fine sandy loam, 0 to 1 percent slopes.		6-34	Sandy clay loam.	SC or CL-----	A-6-----
Arvana fine sandy loam, shallow, 0 to 3 percent slopes.	4 to 10 inches of fine sandy loam overlying 6 to 14 inches of moderately permeable, well-drained sandy clay loam horizon deposited over indurated caliche.	0-6	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
		6-20	Sandy clay loam.	SC or CL-----	A-6-----
Arvana loamy fine sand, 0 to 3 percent slopes.	10 to 16 inches of loamy fine sand overlying 14 to 26 inches of moderately permeable, well-drained sandy clay loam; on a thin, sandy, eolian mantle deposited over indurated caliche.	0-18	Loamy fine sand and fine sandy loam.	SM-----	A-2-----
		18-34	Sandy clay loam.	SC or CL-----	A-6-----

See footnotes at end of table.

County, Tex., and their estimated physical properties

Percentage passing sieve			Permeability	Structure	Available water	pH	Dispersion	Shrink-swell potential
No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)						
87	100	100	<i>Inches per hour</i> 0.25-0.8	Subangular blocky to granular.	<i>Inches per foot of depth</i> 2.4	7.0-7.5	Moderate-----	Moderate.
92	100	100	.25-0.8	Blocky-----	2.3-2.7	7.5-8.0	Moderate-----	Moderate.
91	100	100	.25-0.8	-----	1.5	8.0-8.5	Moderate-----	Moderate.
29-55	100	100	.5-2.0	Structureless and subangular blocky.	1.5-1.8	7.5-7.8	Moderate to high.	Low.
42-58	100	100	.5-2.0	Prismatic and subangular blocky.	1.5-1.8	7.5-8.2	Moderate-----	Low to moderate.
23-71	46-100	100	.5-2.0	Subangular blocky-----	1.6-1.8	7.5-8.4	Moderate-----	Moderate.
12-29	100	100	1.0-2.0	Structureless-----	1.4	7.5-7.8	High-----	Low to moderate.
59-69	100	100	1.0-2.0	Prismatic and subangular blocky.	1.4-1.6	7.5-8.2	Moderate-----	Low to moderate.
23-71	46-100	100	1.0-2.0	Subangular blocky-----	1.5-1.6	7.5-8.4	Moderate-----	Low to moderate.
59-69	100	100	.5-1.5	Structureless-----	1.8	7.6-7.1	Moderate-----	Low.
63-76	100	100	.5-1.5	Prismatic and subangular blocky.	1.6-2.4	7.1-7.9	Moderate-----	Low to moderate.
29-55	100	100	1.0-2.0	Structureless-----	2.0-1.4	7.5-7.8	High-----	Low.
75-90	100	100	1.0-2.0	Prismatic and subangular blocky.	1.4-1.6	7.5-8.2	High-----	Low.
23-71	46-100	100	1.0-2.0	Subangular blocky-----	.8-1.4	7.5-8.4	High-----	Low.
12-29	100	100	1.0-2.0	Structureless-----	1.4-1.8	7.5-7.8	High-----	Low.
23-71	46-100	100	1.0-2.0	Subangular blocky-----	1.8-1.6	7.5-7.8	High-----	Low.
29-55	100	100	.5-2.0	Structureless-----	1.8	7.5-7.8	High-----	Low to moderate.
42-58	100	100	.5-2.0	Subangular blocky-----	1.4-1.8	7.5-8.2	Moderate-----	Low to moderate.
29-55	100	100	2.0-3.5	Structureless-----	1.8	7.5-7.8	High-----	Low to moderate.
42-58	100	100	2.0-3.5	Subangular blocky-----	.8-1.8	7.5-8.2	Moderate-----	Low to moderate.
12-29	100	100	1.0-2.0	Structureless-----	1.4	7.5-7.8	High-----	Low to moderate.
42-58	100	100	1.0-2.0	Prismatic and subangular blocky.	1.4-1.6	7.5-8.2	Moderate-----	Low to moderate.

TABLE 6.—*Engineering description of soils in Dawson County*

Soil name	Soil description	Depth and thickness of horizons in typical profile	Classification		
			USDA	Unified ¹	AASHTO ²
Bippus clay loam, 1 to 3 percent slopes.	20 to 30 inches of moderately permeable, well-drained clay loam on strongly calcareous alluvium washed from nearby slopes that are underlain by calcareous outwash; along eastern edge of rolling plains.	<i>Inches</i> 0-10	Clay loam.....	ML.....	A-4.....
Bippus clay loam, 0 to 1 percent slopes.		10-30	Clay loam.....	ML.....	A-4.....
Bippus clay loam, 3 to 5 percent slopes.		30-60	Clay loam.....	CL.....	A-4, A-6, or A-7.
Brownfield fine sand, thin surface, 0 to 3 percent slopes.	10 to 18 inches of fine sand over 20 to 30 inches of well-drained, moderately permeable sandy clay loam on sandy earth that appears to be eolian; in some places hard caliche is at depths of 3 to 7 feet; on high plains.	0-14	Fine sand.....	SM.....	A-2.....
Brownfield fine sand, 0 to 3 percent slopes, eroded.		14-72	Sandy clay loam..	SC.....	A-6.....
Brownfield fine sand, thick surface, 0 to 3 percent slopes.	28 to 30 inches of fine sand over 20 to 30 inches of well-drained, moderately permeable sandy clay loam on sandy earths that appear to be eolian; in some places hard caliche is at depths of 3 to 7 feet; on high plains.	0-28	Fine sand.....	SM.....	A-2.....
		28-58	Sandy clay loam..	SC.....	A-6.....
Drake fine sandy loam, 1 to 3 percent slopes.	12 to 20 inches of strongly calcareous, well-drained fine sandy loam and sandy clay loam on eolian deposits of playas; over very strongly calcareous sandy clay loam or clay loam; in southern part of high plains.	0-8	Fine sandy loam..	SM or CL-SM..	A-2 or A-4...
		8-20	Sandy clay loam..	SC or CL.....	A-6.....
		20-36	Clay loam.....	CL.....	A-6.....
Drake soils, 3 to 5 percent slopes..	12 to 20 inches of strongly calcareous, well-drained fine sandy loam and sandy clay loam on eolian deposits of playas; over very strongly calcareous sandy clay loam or clay loam; in southern part of high plains.	0-8	Fine sandy loam..	SM or CL-SM..	A-2 or A-4...
		8-20	Sandy clay loam..	SC or CL.....	A-6.....
		20-36	Clay loam.....	CL.....	A-6.....
Kimbrough soils, 1 to 5 percent slopes.	2 to 12 inches of well-drained clay loam overlying thick beds of hard caliche.	0-8	Light clay loam..	CL.....	A-4.....
		8+	Hard caliche....		
Mansker fine sandy loam, 1 to 3 percent slopes.	12 to 22 inches of well-drained, strongly calcareous fine sandy loam and sandy clay loam overlying medium- to fine-textured sediments of outwash material that was washed from the high plains; on high plains and rolling plains.	0-16	Fine sandy loam and sandy clay loam.	SM or CL-SM..	A-2 or A-4...
Mansker fine sandy loam, 0 to 1 percent slopes.		16+	White chalky earth.	CL.....	A-6.....
				Mansker fine sandy loam, 3 to 5 percent slopes.	
Mansker clay loam, 0 to 1 percent slopes.	12 to 22 inches of well-drained clay loam on strongly calcareous, medium- to fine-textured sediments of outwash material that was washed from the high plains; on high plains and rolling plains.	0-8	Light clay loam..	CL.....	A-4.....
Mansker clay loam, 1 to 3 percent slopes.		8-16	Clay loam.....	CL.....	A-6.....
Mansker clay loam, 3 to 5 percent slopes.		16-40	Hard caliche....	CL.....	A-4.....
Miles sandy clay loam, 1 to 3 percent slopes.	32 to 48 inches of moderately permeable, well-drained clay loams on sandy calcareous earth; mostly from outwash on old alluvium of the Quaternary and Pliocene periods; on rolling plains.	0-6	Sandy clay loam..	CL.....	A-4 or A-6...
Miles sandy clay loam, 0 to 1 percent slopes.		6-24	Clay loam.....	CL.....	A-6.....
		24-46	Sandy clay loam..	SC or CL.....	A-6.....

See footnotes at end of table.

Tex., and their estimated physical properties—Continued

Percentage passing sieve			Permeability	Structure	Available water	pH	Dispersion	Shrink-swell potential
No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)						
85	95	97	<i>Inches per hour</i> 1. 0-1. 5	Subangular blocky and granular.	<i>Inches per foot of depth</i> 2. 4	7. 5-7. 8	Moderate-----	Moderate.
70	92	96	. 4-0. 8	Prismatic and subangular blocky.	2. 0	7. 5-8. 2	Moderate-----	Moderate.
70	85	90	. 5-1. 0	Subangular blocky and granular.	2. 0-1. 2	7. 5-8. 2	Moderate-----	Moderate.
21	100	99	1. 0-2. 0	Structureless-----	1. 0-1. 4	7. 6	High-----	Low to moderate.
36-42	100	100	1. 0-2. 0	Prismatic and subangular blocky.	1. 5-1. 8	7. 2-8. 3	Moderate-----	Low to moderate.
12	100	100	1. 5-3. 0	Structureless-----	1. 0-1. 4	6. 5-7. 0	High-----	Low to moderate.
39	100	100	1. 5-3. 0	Prismatic and subangular blocky.	1. 5	7. 0-7. 5	Moderate-----	Low to moderate.
29-55	100	100	2. 0-3. 5	Structureless-----	1. 1-1. 8	7. 5-8. 2	High-----	Low.
42-58	100	100	2. 0-3. 5	Subangular blocky-----	. 8-1. 1	7. 5-8. 2	High-----	Low.
63	100	100	2. 0-3. 5	Subangular blocky-----	. 8-1. 1	7. 5-8. 2	High-----	Low.
29-55	100	100	2. 0-3. 5	Structureless-----	1. 8-1. 1	7. 5-8. 2	High-----	Low.
42-58	100	100	2. 0-3. 5	Subangular blocky-----	. 8-1. 1	7. 5-8. 2	High-----	Low.
63	100	100	2. 0-3. 5	Subangular blocky-----	. 8-1. 1	7. 5-8. 2	High-----	Low.
56	94	96	. 5-1. 0	Subangular blocky-----	1. 2-1. 5	6. 5-7. 0	Moderate-----	Low.
				Structureless-----			Moderate-----	Low.
29-55	100	100	2. 0-3. 5	Structureless, prismatic, and weak subangular blocky.	1. 8	8. 0-8. 5	High-----	Moderate.
81	100	100	2. 0-3. 5	Structureless-----	. 8-1. 8	8. 0-8. 5	High-----	Moderate.
56-59	94-100	96-100	. 5-1. 0	Subangular blocky-----	2. 0	8. 0-8. 5	Moderate-----	Moderate.
64	98	99	. 5-1. 0	Prismatic and subangular blocky.	2. 0	8. 0-8. 5	Moderate-----	Moderate.
56-77	83-98	86-99	. 5-1. 0	Structureless-----	8		Moderate-----	Moderate.
59-69	100	100	. 5-1. 5	Subangular blocky-----	2. 4	8. 0-8. 5	High-----	Low to moderate.
63	100	100	. 5-1. 5	Prismatic and subangular blocky.	1. 6-2. 4	8. 0-8. 5	High-----	Low to moderate.
42-58	100	100	. 5-1. 5	Prismatic and subangular blocky.	1. 6	8. 0-8. 5	High-----	Low to moderate.

TABLE 6.—*Engineering description of soils in Dawson County,*

Soil name	Soil description	Depth and thickness of horizons in typical profile	Classification		
			USDA	Unified ¹	AASHTO ²
Portales clay loam, 0 to 1 percent slopes.	24 to 40 inches of calcareous, moderately permeable, well-drained clay loam on limy sediments that are underlain by a thick layer of whitish, soft caliche; on high plains.	<i>Inches</i> 0-16	Clay loam-----	CL-----	A-4, A-6, or A-7.
Portales clay loam, 1 to 3 percent slopes.		16-26	Clay loam-----	ML-----	A-4-----
		26-72	Clay loam-----	CL-----	A-4, A-6, or A-7.
Portales fine sandy loam, 0 to 1 percent slopes.	24 to 40 inches of calcareous, moderately permeable, well-drained fine sandy loam and sandy clay loam on sediments that are underlain by a thick layer of whitish soft caliche; on high plains.	0-6	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
Portales fine sandy loam, 1 to 3 percent slopes.		6-30	Sandy clay loam.	SC or CL-----	A-6-----
		30-48	Clay loam-----	CL-----	A-6-----
Potter soils, 8 to 30 percent slopes.	4 to 10 inches of strongly calcareous, well-drained fine sandy loam, on deep beds of soft or only weakly indurated caliche; on high plains and rolling plains.	0-9	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
		9-14	Hard caliche----		
Randall clay-----	4 to 5 feet of poorly drained clay on the floors of enclosed depressions or intermittent lakes; on the southern part of high plains.	0-15	Clay-----	CL-----	A-7-----
		15-46	Clay-----	CL-CH-----	A-7-----
		46-55	Clay-----	CH-CL-----	A-7-----
Randall fine sandy loam, overblown.	6 to 10 inches of fine sandy loam over 4 to 5 feet of poorly drained clay on the floors of enclosed depressions or intermittent lakes; on the southern part of the high plains.	0-6	Fine sandy loam.	SM or CL-SM..	A-2 or A-4...
		6-21	Clay-----	CL-----	A-7-----
		21-52	Clay-----	CL-CH-----	A-7-----
Spur clay loam-----	4 to 5 feet of well-drained, calcareous, alluvial clay loam on flood plains of ancient draws; high water table occurs at times; on high plains and rolling plains.	0-20	Clay loam-----	ML-----	A-4-----
		20-40	Clay loam-----	CL-----	A-6 or A-7...
Spur fine sandy loam-----	4 to 5 feet of well-drained, calcareous, alluvial fine sandy loam on flood plains of ancient draws; high water table occurs at times; on high plains and rolling plains.	0-20	Fine sandy loam.	SM-----	A-4-----
		20-40	Fine sandy loam.	ML-----	A-4-----
		40-60	Fine sandy loam.	ML-----	A-4-----
Tivoli fine sand-----	6 to 7 feet of well-drained fine sand on wind deposits of the Quaternary period; on high plains.	0-8	Fine sand-----	SM-----	A-2-----
		8-72	Fine sand-----	SM-----	A-2-----
Vernon soils, 1 to 8 percent slopes.	5 to 10 inches of poorly drained clay, mainly on calcareous shales or clays; on rolling plains.	0-6	Clay-----	CL-----	A-7-----
		6-40	Clay or shale----	CL-----	A-7-----
Vona loamy fine sand, 0 to 3 percent slopes.	2 to 3 feet of well-drained loamy fine sand on calcareous eolian sands in low-lying, nearly level, concave positions; in southern part of high plains.	0-30	Loamy fine sand and fine sandy loam.	SM-----	A-4-----
		30-48	Sandy clay loam.	SC or CL-----	A-4 or A-6...
Zita fine sandy loam, 0 to 1 percent slopes.	4 to 10 inches of fine sandy loam overlying 14 to 20 inches of well-drained fine sandy loam and sandy clay loam on highly calcareous eolian material; on high plains.	0-8 8-30	Fine sandy loam. Fine sandy loam and sandy clay loam.	SM or CL-SM.. SC or CL-----	A-2 or A-4.. A-6-----

¹ Based on The Unified Soil Classification System, Technical Memorandum No. 3-357, vol. 1, Waterways Experiment Station, Corps of Engineers, March 1953.

² Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1): Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHTO Designation: M 145-49.

Tex., and their estimated physical properties—Continued

Percentage passing sieve			Permeability	Structure	Available water	pH	Dispersion	Shrink-swell potential
No. 200 (0.074 mm.)	No. 10 (2.0 mm.)	No. 4 (4.7 mm.)						
85	95	98	<i>Inches per hour</i> 1. 0-1. 5	Prismatic subangular blocky	<i>Inches per foot of depth</i> 2. 2	8. 0-8. 5	Moderate	Moderate.
85	88	90	. 5-1. 0	Granular	1. 6	8. 0-8. 5	Moderate	Low.
85	86	88	. 5-1. 0	Granular	1. 8	8. 0-8. 5	Moderate	Low.
29-55	100	100	2. 0-3. 5	Structureless	1. 1-1. 8	8. 0-8. 1	High	Moderate.
42-58	100	100	1. 6-1. 8	Prismatic, subangular blocky, and granular.	1. 5-1. 8	8. 0-8. 1	High	Moderate.
64	98	99	1. 0-3. 0	Prismatic, subangular blocky, and granular.	1. 4	8. 1	High	Low.
29-55	100	100	2. 0-3. 5	Prismatic, subangular blocky, and granular.	1. 1-1. 8	8. 0-8. 5	High	Low.
				Structureless			High	Low.
79	100	100	. 1-0. 5	Blocky	2. 4	7. 5-8. 0	Low	High.
89	100	100	. 1-0. 5	Blocky	2. 4	7. 5-8. 0	Low	High.
83	100	100	. 1-0. 5	Blocky	2. 4	7. 5-8. 0	Low	High.
29-55	100	100	2. 0-3. 5	Prismatic, subangular blocky, and granular.	1. 1-1. 8	8. 0-8. 5	High	Low.
79	100	100	. 1-0. 5	Blocky	2. 4	7. 5-8. 0	Low	High.
89	100	100	. 1-0. 5	Blocky	2. 4	7. 5-8. 0	Low	High.
80	94	98	1. 0-1. 5	Prismatic and subangular blocky.	2. 4	8. 0-8. 5	Moderate	Moderate.
85	95	96	. 3-0. 8	Prismatic	2. 0	8. 0-8. 5	Moderate	Moderate.
42	95	98	1. 0-3. 0	Granular	1. 5	8. 0-8. 5	Moderate	Low.
60	94	96	. 5-1. 0	Granular	1. 7	8. 0-8. 5	Moderate	Low.
60	94	96	. 5-1. 0	Subangular blocky	1. 7	8. 0-8. 5	Moderate	Low.
12	87	100	3+	Structureless	. 5- . 75	7. 2-7. 5	Low	Low.
12	87	100	3+	Structureless	. 5- . 75	7. 2-7. 5	Low	Low.
79	100	100	. 1-0. 5	Fine, irregular blocky	2. 4	7. 5-8. 0	Low	High to moderate.
89	100	100	. 1-0. 5	Fine, irregular blocky	2. 4	7. 5-8. 0	Low	High to moderate.
45	93	96	2. 0-5. 0	Structureless	. 8	7. 5-8. 0	High	Low.
23-71	46-100	100	1. 0-2. 0	Subangular blocky	. 8-1. 4	7. 5-8. 4	High	Low.
29-55	100	100	2. 0-3. 5	Structureless	1. 1-1. 8	7. 0-7. 4	High	Low.
42-58	100	100	. 5-2. 0	Prismatic and subangular blocky.	1. 6-1. 8	7. 5-8. 0	High	Low.

TABLE 7.—*Engineering interpretation*

Soil type	Suitability for road subgrade	Suitability as a source of topsoil	Soil features affecting—	
			Dikes and levees	Farm ponds
				Reservoir area
Abilene clay loam.....	Poor.....	Surface layer good...	Slow permeability; good stability.	Slow permeability; calcareous substratum.
Amarillo fine sandy loam....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; highly calcareous substratum.
Amarillo loamy fine sand....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability; high susceptibility to wind erosion.	Moderate permeability; highly calcareous substratum.
Amarillo sandy clay loam....	Poor.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; calcareous substratum.
Arch fine sandy loam.....	Poor.....	Surface layer satisfactory.	Moderate permeability; good stability but will seep.	Moderate permeability; highly calcareous subsoil.
Arch loamy fine sand, overblown.	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; poor stability; high susceptibility to wind erosion.	Moderate permeability; highly calcareous subsoil.
Arvana fine sandy loam.....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability; hard caliche at depths from 20 to 36 inches.	Moderate permeability; highly calcareous substratum.
Arvana fine sandy loam, shallow.	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good stability; hard caliche at depths from 10 to 20 inches.	Moderate permeability; hard caliche substratum.
Arvana loamy fine sand.....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability; high susceptibility to wind erosion.	Moderate permeability; hard caliche substratum.
Bippus clay loam.....	Poor.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; calcareous substratum.
Brownfield fine sand, thin surface.	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability; high susceptibility to wind erosion.	Moderate permeability; highly calcareous substratum.
Brownfield fine sand, thick surface.	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability; high susceptibility to wind erosion.	Moderate permeability; highly calcareous substratum.
Brownfield fine sand, eroded..	(!).....	(!).....	Moderate permeability; good to poor stability; high susceptibility to wind erosion.	Moderate permeability; highly calcareous substratum.
Drake fine sandy loam.....	Fair.....	Surface layer satisfactory.	Moderately rapid permeability; poor stability; high susceptibility to wind erosion.	Moderately rapid permeability; highly calcareous subsoil.
Drake soils.....	Fair.....	Surface layer satisfactory.	Moderately rapid permeability; poor stability; high susceptibility to wind erosion.	Moderately rapid permeability; highly calcareous subsoil.
Kimbrough soils.....	Good to fair.....	Surface layer thin but satisfactory.	Moderate to rapid permeability; soft or hard caliche at depths less than 10 inches.	Moderate to rapid permeability; soft caliche subsoil at depths less than 10 inches.

See footnote at end of table.

for soils in Dawson County, Tex.

Soil features affecting—Continued

Farm ponds—Continued	Irrigation	Terraces and diversions	Waterways
Embankment			
Soil material well graded and stable.	Slow permeability-----	Subject to erosion; high water-holding capacity; slow permeability.	Subject to erosion but can support vegetation.
Soil material well graded-----	Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity.	Highly calcareous subsoil.
Surface soil poorly graded; subsoil well graded.	Moderate permeability; high susceptibility to wind erosion; low water-holding capacity.	High susceptibility to wind erosion; surface soil poorly graded.	High susceptibility to wind erosion.
Soil material well graded and stable; can be made impervious by wet compaction.	Moderate permeability; deepness of soil; high water-holding capacity.	Moderate permeability; subject to erosion; high water-holding capacity.	Subject to erosion.
Soil material well graded; highly calcareous; subject to wind erosion.	Moderate permeability; low water-holding capacity.	Subject to wind erosion; moderate permeability; low water-holding capacity.	Moderate permeability; subject to wind erosion; low water-holding capacity.
Surface soil poorly graded; subsoil well graded.	Moderate permeability; high susceptibility to wind erosion; low water-holding capacity.	High susceptibility to wind erosion; highly calcareous subsoil.	High susceptibility to wind erosion; calcareous subsoil.
Soil material well graded-----	Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity.	Highly calcareous subsoil; hard caliche at depths from 20 to 36 inches.
Soil material well graded-----	Shallow depth; low water-holding capacity.	Shallow depth; hard caliche at depths from 10 to 20 inches.	Shallow depth; hard caliche at depths from 10 to 20 inches.
Soil material well graded-----	Moderate permeability; high susceptibility to wind erosion; moderate water-holding capacity.	High susceptibility to wind erosion; hard caliche substratum.	High susceptibility to wind erosion; hard caliche substratum.
Soil material well graded and stable; can be made impervious by wet compaction.	Moderate permeability; deep soil; high water-holding capacity.	Moderate permeability; subject to erosion; high water-holding capacity.	Subject to erosion.
Surface soil poorly graded; subsoil well graded.	Moderate permeability; high susceptibility to wind erosion; surface soil has low water-holding capacity.	Surface soil has high susceptibility to wind erosion; subsoil well graded.	Surface soil has high susceptibility to wind erosion; subsoil well graded.
Surface soil poorly graded; subsoil well graded.	Moderate permeability; high susceptibility to wind erosion; low water-holding capacity.	High susceptibility to wind erosion; surface soil poorly graded.	High susceptibility to wind erosion.
Soil material poorly graded; subsoil well graded.	Moderate permeability; high susceptibility to wind erosion; surface soil has low water-holding capacity.	Surface soil has high susceptibility to wind erosion; subsoil well graded.	Surface soil has high susceptibility to wind erosion; subsoil well graded.
Soil material well graded-----	Moderately rapid permeability; low water-holding capacity; high susceptibility to wind erosion.	Poor stability; high susceptibility to wind erosion; highly calcareous subsoil.	High susceptibility to wind erosion; highly calcareous subsoil.
Soil material well graded-----	Moderately rapid permeability; low water-holding capacity; high susceptibility to wind erosion.	Poor stability; high susceptibility to wind erosion; highly calcareous subsoil.	High susceptibility to wind erosion; highly calcareous subsoil.
Soil material rocky and stony---	Moderately rapid permeability; very shallow depth.	Very shallow surface soil; soft caliche at depths less than 10 inches; soil material stony throughout.	Very shallow surface soil; soft caliche at depths less than 10 inches; stony throughout profile.

TABLE 7.—*Engineering interpretation for*

Soil type	Suitability for roads subgrade	Suitability as a source of topsoil	Soil features affecting—	
			Dikes and levees ¹	Farm ponds
				Reservoir area
Mansker fine sandy loam.....	Poor to fair.....	Surface layer satisfactory.	Moderate to rapid permeability; fair stability; soft caliche at depths from 10 to 20 inches.	Moderate to rapid permeability; soft caliche subsoil.
Mansker clay loam.....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good stability; soft caliche at depths from 10 to 20 inches; moderate susceptibility to wind erosion.	Moderate permeability; soft caliche subsoil.
Miles sandy clay loam.....	Poor.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; calcareous substratum.
Portales clay loam.....	Poor.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; calcareous substratum.
Portales fine sandy loam.....	Fair.....	Surface layer satisfactory.	Moderately rapid permeability; poor stability.	Moderately rapid permeability; highly calcareous subsoil.
Potter soils.....	Good to fair.....	Surface layer thin but satisfactory.	Moderate to rapid permeability; soft or hard caliche at depths less than 10 inches.	Moderate to rapid permeability; soft caliche subsoil at depths less than 10 inches.
Randall clay.....	Poor.....	Poor.....	Very slow permeability; fair stability; intermittently wet; high shrink-swell potential.	Very slow permeability; high shrink-swell potential; will crack.
Randall fine sandy loam, overblown.	Poor.....	Poor.....	Very slow permeability; fair stability; intermittently wet; high shrink-swell potential.	Very slow permeability; high shrink-swell potential; will crack.
Spur clay loam.....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability.....
Spur fine sandy loam.....	Poor to fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; highly calcareous substratum.
Stony rough land, Potter material.	(¹).....	Poor.....	Steep slopes; limestone rock covering 85 percent of surface.	Steep slopes; limestone rock on surface.
Tivoli fine sand.....	Fair.....	Surface layer satisfactory.	Moderately rapid permeability; low stability; high susceptibility to wind erosion; hard caliche at depths from 20 to 36 inches.	Moderately rapid permeability; soil material sandy.
Vernon soils.....	Poor.....	Poor.....	Very slow permeability; high shrink-swell potential.	Very slow permeability; calcareous substratum.
Vona loamy fine sand.....	Fair to good.....	Surface layer satisfactory.	Moderately rapid permeability; poor stability; high susceptibility to wind erosion.	Moderately rapid permeability; highly calcareous subsoil.
Zita fine sandy loam.....	Fair.....	Surface layer satisfactory.	Moderate permeability; good to poor stability.	Moderate permeability; highly calcareous substratum.

¹ Reliable information not available.

soils in Dawson County, Tex.—Continued

Soil features affecting—Continued			
Farm ponds—Continued	Irrigation	Terraces and diversions	Waterways
Embankment			
Soil material well graded-----	Shallow depth; low water-holding capacity.	Shallow depth; caliche subsoil---	Shallow depth; caliche subsoil at depths from 10 to 20 inches.
Soil material well graded-----	Shallow depth; low water-holding capacity.	Shallow depth; soft caliche at depths from 10 to 20 inches.	Shallow depth; soft caliche at depths from 10 to 20 inches; subject to wind erosion.
Soil material well graded and stable; can be made impervious by wet compaction.	Moderate permeability; deepness of soil; high water-holding capacity.	Moderate permeability; subject to erosion; high water-holding capacity.	Subject to erosion; occurs on more nearly level slopes.
Soil material well graded and stable; can be made impervious by wet compaction.	Moderate permeability; deepness of soil; high water-holding capacity.	Moderate permeability; subject to erosion; high water-holding capacity.	Subject to erosion; occurs on more nearly level slopes.
Soil material well graded-----	Moderately rapid permeability; moderate water-holding capacity.	Poor stability; highly calcareous subsoil.	Highly calcareous subsoil.
Soil material rocky and stony--	Moderately rapid permeability; very shallow depth.	Very shallow surface soil; soft caliche at depths less than 10 inches; stony throughout.	Very shallow surface soil; soft caliche at depths less than 10 inches; stony throughout.
Soil material poorly graded----	Very slow permeability; subject to overflow.	Very slow permeability; subject to overflow; will crack.	Will crack; subject to overflow.
Soil material poorly graded----	Very slow permeability; subject to overflow.	Very slow permeability; subject to overflow; will crack.	Will crack; subject to overflow.
Soil material well graded-----	Susceptible to overflow-----	Susceptible to overflow-----	Susceptible to overflow.
Soil material well graded-----	Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity.	Highly calcareous subsoil.
Steep slopes; limestone rock on surface.	Steep slopes; limestone rock on surface.	Steep slopes; rocks on surface---	Steep slopes; rocks on surface.
Soil material poorly graded----	Moderately rapid permeability; high susceptibility to wind erosion; low water-holding capacity.	Low stability; subject to wind erosion.	Subject to wind erosion; soil material sandy.
Soil material poorly graded; high shrink-swell potential; will crack.	Very slow permeability; very shallow depth.	Very slow permeability; will crack; soil material poorly graded; shallow depth.	Shallow depth; subject to water erosion.
Soil material fairly well graded--	Moderately rapid permeability; highly susceptibility to wind erosion; low water-holding capacity.	Poor stability; high susceptibility to wind erosion.	High susceptibility to wind erosion.
Soil material well graded-----	Moderate permeability; moderate to high water-holding capacity.	Moderate permeability; moderate to high water-holding capacity.	Highly calcareous subsoil.

Irrigation water can be applied to the soils in the county by sprinkler or by flooding. The level-border system and the level- or graded-furrow system are suited to the fine- and medium-textured soils. Sprinklers can be used for irrigating all soils in the county, but they are best suited to the coarse-textured, sandy soils and the soils in rough areas.

Terraces and diversions can be constructed on most soils in the county, but, on the coarser textured soils, they are difficult to maintain. It is difficult to keep the terrace ridges and channels in good condition. Soil material accumulates in channels, and some is blown out of the ridges by the wind.

Wind erosion is also a great hazard to waterways constructed in the area. Windblown materials accumulate in waterways and smother the vegetation. They also hinder the flow of water.

The red clays are suitable for holding water in ponds, but they must be carefully placed and compacted to make good fills. Because these clays have a high shrink-swell potential, they may crack in fills if the materials are poorly placed and poorly compacted. The heavy red clays are the only soils in the area that are suitable to be used in the reservoir area of farm ponds. The top layers of many soils in the county may be suitable for the construction of pond fills, but the underlying layers will not hold water in the reservoir area.

The surface layer of almost all soils in the county can be used for topsoil material. Some soils, however, have a thin surface layer and do not supply much topsoil material. Although a little sand and gravel can be obtained in small overwash areas, no area is large enough for the sand and gravel to be obtained on a commercial basis.

The hard caliche underlying many of the soils in the survey area can be used for subgrade and subbase material. It is also suitable for use in asphalt surfacing if the caliche is properly crushed and graded.

Engineering Test Data

In table 8 are the results from tests of seven soil samples from soils in Lynn County and Haskell County, Tex. The same kinds of soils as those tested also occur in Dawson County. The tests were made according to standard procedure so that the soils could be evaluated for engineering purposes.

The result of a mechanical analysis, obtained by the combined sieve and hydrometer method, can be used to determine the relative proportions of different size particles that make up the soil sample. The clay content obtained by the hydrometer method, which is generally used by engineers, should not be used to determine soil textural classes.

The values of the liquid limit and the plastic limit indicate the effect of water on the consistence of soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a solid to a semisolid, or plastic, state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the material passes from a solid

to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The numerical difference between the liquid limit and the plastic limit is called the plasticity index. It indicates the range of moisture content within which soil material is in a plastic condition.

In a moisture-density test, or compaction test, a sample of soil material is compacted several times with the same compactive effort, each time at a higher moisture content. The dry density (unit weight) of the soil material increases until the "optimum moisture content" is reached. After that, the dry density decreases with an increase in moisture content. The highest dry density obtained in the compaction tests is termed "maximum dry density." Moisture density data are important in earthwork because, as a rule, optimum stability is obtained if the soil is compacted to about maximum dry density when it is at approximately the optimum moisture content.

Tree Windbreaks³

Tree windbreaks are not effective in areas that have an annual rainfall of less than 24 inches unless the soils are carefully managed.

On classes II, III, and IV soils, the trees in the windbreaks can be planted in straight lines if, in the direction of the lines, the slopes are not steeper than 4 percent. The trees also can be planted on contour lines where the contour lines run in about the right direction with respect to the wind. In addition, some combination of straight-line and contour-line planting can be used.

Isolated east-west and north-south windbreaks offer little protection. For maximum protection, the trees must be planted in two directions or in patterns. Even when the wind is perpendicular to an isolated windbreak, the protected area is only about half of what it would be if belts were located at right angles at the ends of the windbreak and at proper intervals between the ends. Quartering winds further reduce the effectiveness of an isolated belt.

Table 9 gives, for dryland and irrigated farming, the ultimate height that the most commonly used shrubs and trees attain on the soils listed. The soils listed are suited to windbreaks. They have an adequate supply of plant food, an adequate depth, and texture and structure that insure good infiltration and the retention of water.

Chinese elm has an extensive growth of roots, and Russian mulberry and honeylocust have an intermediate growth. The roots of the other species listed in table 9 are restricted. If management is good, desert willow, Russian mulberry, vitex, Chinese elm, honeylocust, and Arizona cypress may grow 2 to 3 feet per year. Russian olive, western redcedar, and Chinese aborvitae may grow as much as 2 feet per year.

Specialists in the Soil Conservation Service and other qualified specialists will assist you in laying out the windbreak system and in determining the best spacing and tree or shrub species for your soils.

³ This subsection was written by HORACE E. MITCHELL, soil scientist, Soil Conservation Service.

TABLE 8.—Engineering test data¹ for soil samples taken from 7 soil profiles in Lynn County and Haskell County, Tex.

Soil type	Depth	Classification		Percentage consisting of soil grains smaller than					Liquid limit	Plastic limit	Maximum dry density	Optimum moisture
		Unified ²	AASHO ³	0.050 mm.	0.020 mm.	0.005 mm.	0.002 mm.	0.001 mm.				
Abilene clay loam	Inches										lb. per cu. ft.	Percent
	0-6	CL	A-6(8)	79	48	32	28		29	11	108	27
	24-40	CL	A-7-6(15)	87	63	47	41		46	25	104	21
	40-54	CL	A-6(12)	85	63	52	38		33	19	116	14
Amarillo fine sandy loam	0-6	CL-SM	A-4(4)	48	33	29	25	23	18	5	123	11
	6-46	SC	A-6(2)	33	20	16	13	11	29	14	116	14
	46-94	CL	A-6(8)	60	50	41	27	20	24	12	120	13
	0-11	SM	A-2-4(0)	25	14	13	10	9	NP	NP	120	10
	0-11	CL-SM	A-4(2)	33	18	14	12	10	18	5	123	10
	15-56	CL	A-6(5)	45	24	21	20	18	25	11	120	12
	56-120	SC	A-2-4(0)	20	15	12	9	6	23	9	121	12
	96-140	CL	A-4(7)	67	57	49	31	18	23	10	122	12
Amarillo sandy clay loam	0-6	CL	A-4(6)	53	32	24	21	20	25	10	116	13
	6-38	CL	A-6(10)	60	48	37	32	30	36	19	110	16
	38-80	CL	A-6(10)	75	63	51	35	24	30	16	118	14
	0-9	CL	A-6(6)	49	32	24	23	21	28	13	116	14
	9-30	CL	A-6(8)	54	40	32	30	27	33	16	109	17
	30-60	CL	A-6(9)	67	57	47	33	23	28	13	115	15
	0-10	CL	A-6(9)	63	40	31	26	24	32	16	110	17
	10-40	CL	A-6(12)	67	49	38	34	32	38	19	108	18
Brownfield fine sand, thin surface	0-13	SM	A-2-4(0)	14	7	6	5	3	NP	NP	114	11
	15-84	SC	A-6(1)	31	25	24	24	22	30	15	117	14
	18-65	SC	A-6(3)	37	27	25	24	22	30	15	118	13
Brownfield fine sand, thick surface	1-30	SM	A-2-4(0)	8	3	2	2	0	NP	NP	107	12
	34-38	SC	A-6(1)	31	22	20	19	17	26	12	119	13
Mansker clay loam	0-16	CL	A-4(4)	43	23	18	15	12	23	7	116	13
	16-30	CL	A-4(4)	49	34	28	21	16	25	9	114	15
	0-16	CL	A-4(5)	50	33	27	22	19	25	10	117	13
	16-62	CL	A-4(8)	61	49	36	24	19	29	14	114	15
	0-14	CL	A-6(6)	56	41	33	25	17	28	12	117	14
	14-38	CL	A-4(9)	73	65	53	31	19	29	13	115	15
Randall clay	4-40	CL	A-7-6(16)	72	56	47	42	38	45	26	101	22
	2-36	CL-CH	A-7-6(17)	83	66	55	47	44	49	29	102	20
	2-36	CH-CL	A-7-6(18)	75	57	48	43	38	51	33	100	22

¹ Tests performed by Bureau of Public Roads in accordance with standard procedure of the American Association of State Highway Officials.

² Based on The Unified Soil Classification System, Technical Memorandum No. 3-357, vol. 1, Waterways Experiment Station, Corps of Engineers, March 1953.

³ Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1): Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation: M145-49.

⁴ Nonplastic.

Formation, Classification, and Morphology of Soils

This section has three main parts. The first part tells how the soils in Dawson County formed. In the second part, the soil series in the county are listed in their proper soil orders and great soil groups. The third part discusses morphology and contains a table that gives the relief and underlying material of some soil types and lists soil characteristics for the horizons that have developed.

Factors of Soil Formation

Soil is a product of the interaction of climate, living organisms, parent material, relief, and time. This in-

teraction is reflected by the characteristics of the soils that develop on the surface of the earth.

Climate and vegetation are active forces in soil formation. They act slowly on the parent material that has accumulated through the weathering of rocks, and a natural body forms that has genetically related horizons. Relief modifies the effects of climate and vegetation, and the parent material has much to do in determining the kind of profile that develops. In some places, a profile develops that is almost entirely the result of the effects of parent material. Finally, time is needed for changing the parent material into a soil profile. It generally takes a long time for distinct horizons to develop.

Because the interrelationships among the factors of soil formation are complex, it is difficult to specify with certainty the effects of any one factor. Therefore, when

TABLE 9.—*Soils suitable for planting trees and shrubs for windbreaks and*

Suitable soils	Shrubs							
	Desert willow		Russian-olive		Vitex		Russian mulberry	
	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated
Amarillo fine sandy loam, 0 to 1 percent slopes.....	<i>Feet</i> 8	<i>Feet</i> 20	<i>Feet</i> 5	<i>Feet</i> 15	<i>Feet</i> 6	<i>Feet</i> 12	<i>Feet</i> 12	<i>Feet</i> 30
Amarillo loamy fine sand, 0 to 3 percent slopes.....	12	22	7	16	8	14	18	34
Arch fine sandy loam, 0 to 1 percent slopes.....	14	20	7	15	8	12	20	30
Arch loamy fine sand, 0 to 3 percent slopes, overblown.....	12	22	7	16	7	12	18	34
Arvana fine sandy loam, 0 to 1 percent slopes.....	8	20	5	15	6	12	12	30
Arvana loamy fine sand, 0 to 3 percent slopes.....	12	22	7	16	7	14	18	34
Brownfield fine sand, thin surface, 0 to 3 percent slopes.....	12	22	7	16	7	14	18	34
Drake fine sandy loam, 1 to 3 percent slopes.....	14	20	7	15	8	12	20	30
Drake soils, 3 to 5 percent slopes.....	8	20	5	15	8	12	12	30
Portales fine sandy loam, 0 to 1 percent slopes.....	14	20	7	15	12	7	20	30

¹ Not suited to this soil unless irrigated.

discussing the effects of a single factor, it should be remembered that the soil profile is a result of the interaction of all factors.

Climate

The subhumid, warm-temperate, continental climate of Dawson County has a definite effect on the formation of soils. Most of the zonal and intrazonal soils have a horizon of calcium carbonate that forms mainly because rainfall is limited. The soil is seldom wet below the living plant roots. Many of the young soils have free lime throughout the profile because the lime has not been leached. The profile shown in figure 15 is one of a relatively young soil.

The small amount of water moving through the profile had another effect. This water carried clay particles

from the surface horizon to the subsoil, or underlying layer. When the movement of the water slowed, these clay particles were deposited. The clay that accumulated in the subsoil further slowed the water and caused an even greater rate of clay accumulation. Organic matter also accumulated in the subsoil. The zones of clay and organic-matter accumulation in the B horizon are shown graphically in figure 16. In this figure the leaching of free calcium carbonate from the solum is indicated by the pH line.

From geologic time to the present, the strong, variable wind in Dawson County affected the formation of soils. In the Illinoian age of the Pleistocene era, "cover sands" were deposited over alluvial materials. Today coarse sands are being shifted on the surface.

Living organisms

The mixed native vegetation affected the formation of soils more than other living organisms. This vegetation was the prairie type and ranged from short and mid grasses on the clay loams to postclimax tall grasses and shin oak on the sandy soils. Large amounts of organic matter were distributed on the surface of the soil after the grass stems and leaves decomposed and throughout the solum after the fine roots decayed. These decaying roots left a network of tubes and pores that allowed air and water to move more freely through the soil. The organic matter also provided abundant food for soil bacteria, actinomyces, and fungi.

Even though rainfall is low and at times the entire solum is dry, evidence of soil mixing by earthworms is apparent. Worm casts make up about 40 percent of some Amarillo soils. Worm working allows air, water, and plant roots to move more freely through the soil.

Colonies of prairie dogs have occupied local areas as large as 40 acres. These animals did much to hinder the



Figure 15.—Portales fine sandy loam, 0 to 1 percent slopes. The A₁ horizon is the dark surface layer. The AC horizon extends from the bottom of the A₁ horizon to the point of the shovel, where the C_{ca} horizon begins.

ultimate average heights of some suitable species on dryland and on irrigated soils

Deciduous trees						Evergreens					
Cottonwood		Chinese elm		Honeylocust		Arizona cypress		Western redcedar		Chinese arborvitae	
Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated	Dryland	Irrigated
Feet (1)	Feet 50	Feet 20	Feet 45	Feet 18	Feet 35	Feet 25	Feet 35	Feet 22	Feet 35	Feet 15	Feet 22
(1)	50	25	48	18	38	25	38	25	35	18	22
45	50	25	45	22	35	28	35	28	35	18	22
(1)	50	25	38	18	38	28	38	28	35	18	22
(1)	50	20	45	18	35	25	35	22	35	18	22
(1)	50	25	48	18	38	28	38	28	35	15	22
(1)	50	25	48	18	38	28	38	28	35	18	22
45	50	25	48	22	35	28	35	28	35	18	22
(1)	50	20	45	18	35	25	35	22	35	18	22
45	50	25	45	22	38	28	35	28	35	15	22

leaching of free lime. Their burrowing destroyed soil structure. In areas that were areas of Amarillo sandy clay loam before the prairie dog made his home, the profile is calcareous to the surface. It has a weaker structure than the surrounding normal Amarillo soil and a weaker

C_{ca} horizon. Soils of this kind have characteristics similar to the Portales soils and were mapped as Portales soils.

Man has also affected the development of soil. He fenced the range, allowed it to be overgrazed, and changed the vegetation. Then he plowed the soil and planted crops. After the crops were harvested, runoff and water and wind erosion increased. This reduced the amount of organic matter in the plow layer and the amount of silt and clay particles. Heavy machinery and ill-timed tillage compacted layers and reduced water infiltration and aeration. Man, in effect, even changed the climate in some areas by irrigating and increasing the amount of available water. These actions have had marked effects on the soils of the county, although they have been going on for only about 50 years.

Parent materials

All soils on the high plains in the county have developed from Quaternary or late Tertiary materials that are commonly called Rocky Mountain outwash. The parent materials in these areas are largely of alkaline to calcareous, unconsolidated, sandy and silty earths. This alluvium may have been reworked by the wind or affected by a high water table many times since it was first deposited. Some areas that, apparently, were shallow enclosed basins have had lime added from surrounding slopes. Eight profiles in adjacent Lynn County that were studied have similar gross mineralogy even though texture ranges from fine sand to clay. The chemical and mineralogical properties for the clay fractions are strikingly similar for all eight profiles.

The block diagrams in figure 17 show the kinds of parent material that underlies the soils in Dawson County in four different areas on the high plains and the rolling plains.

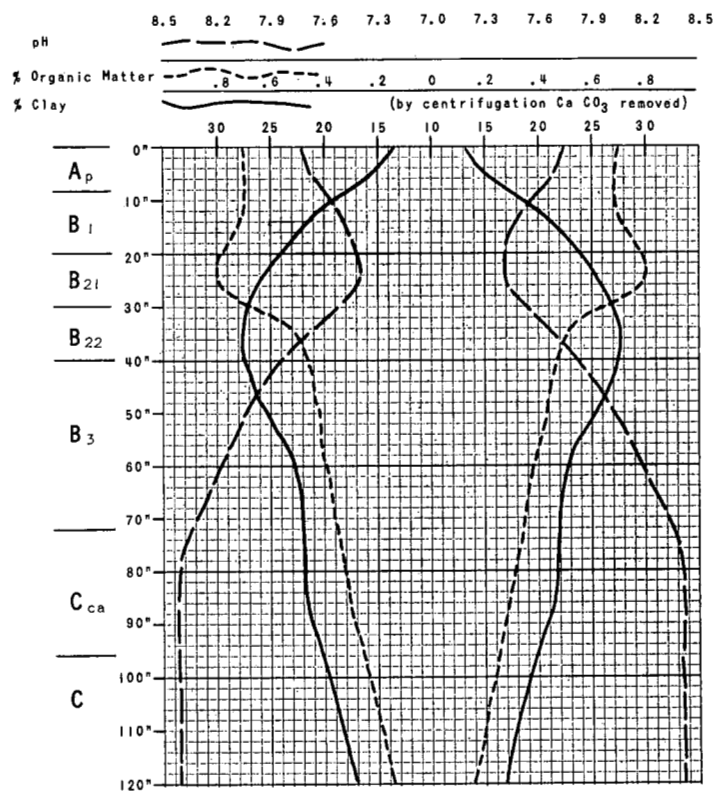


Figure 16.—The pH, percent of organic matter, and clay in horizons of Amarillo fine sandy loam.

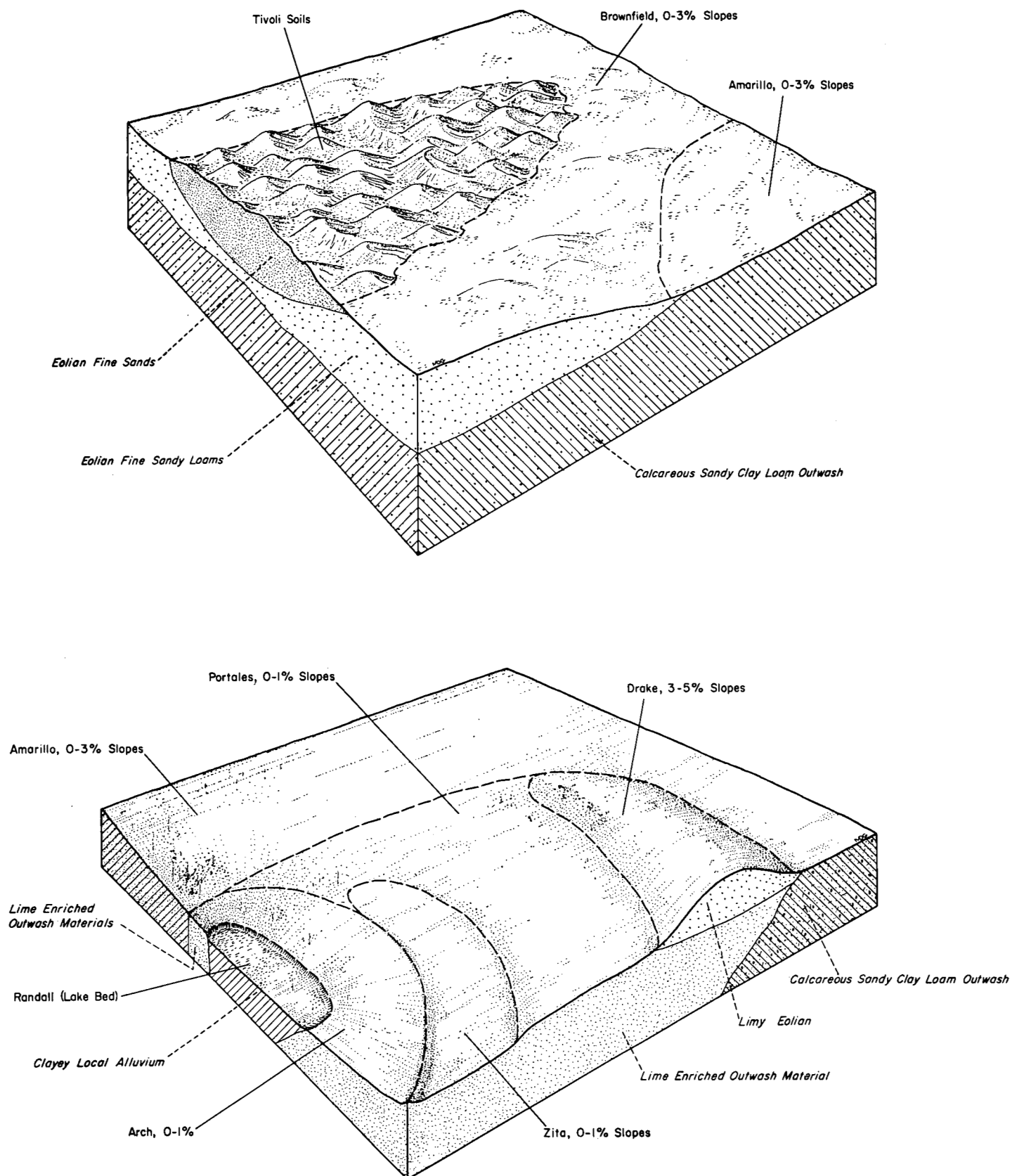
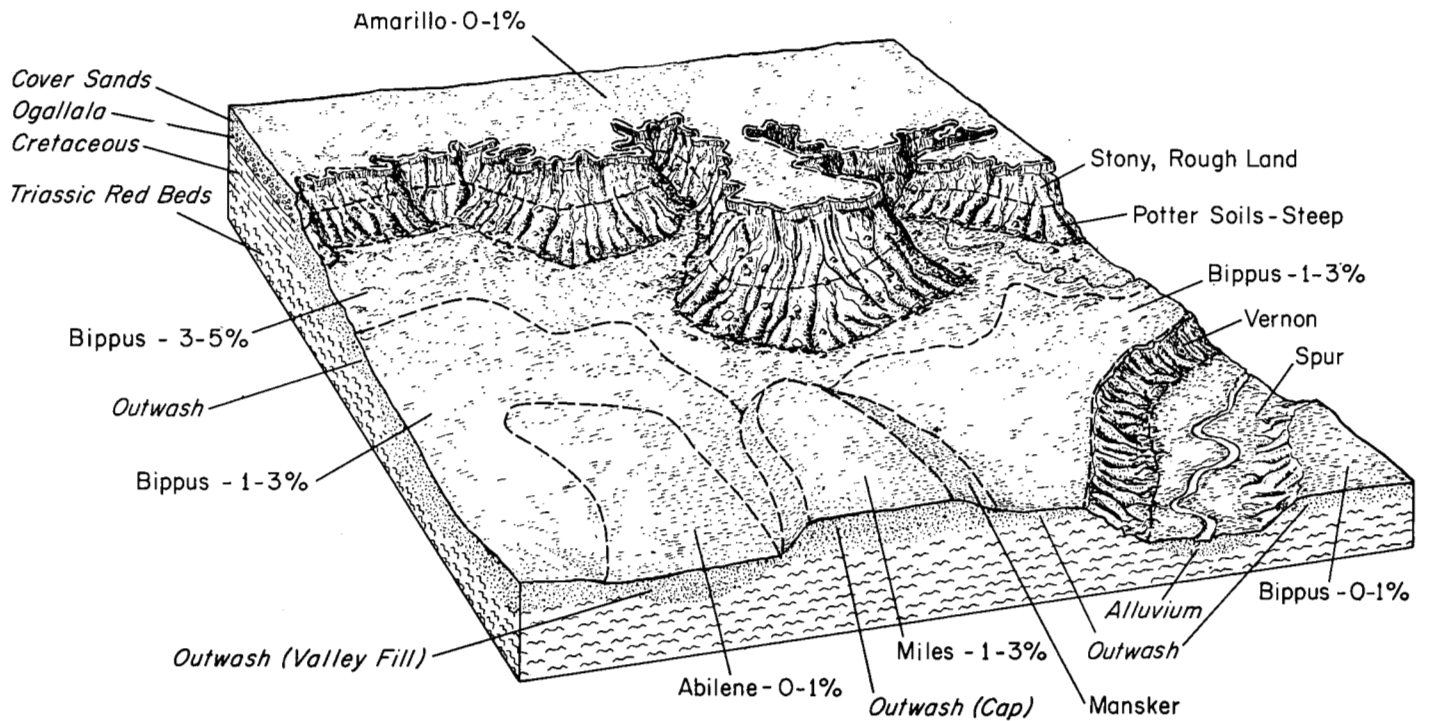
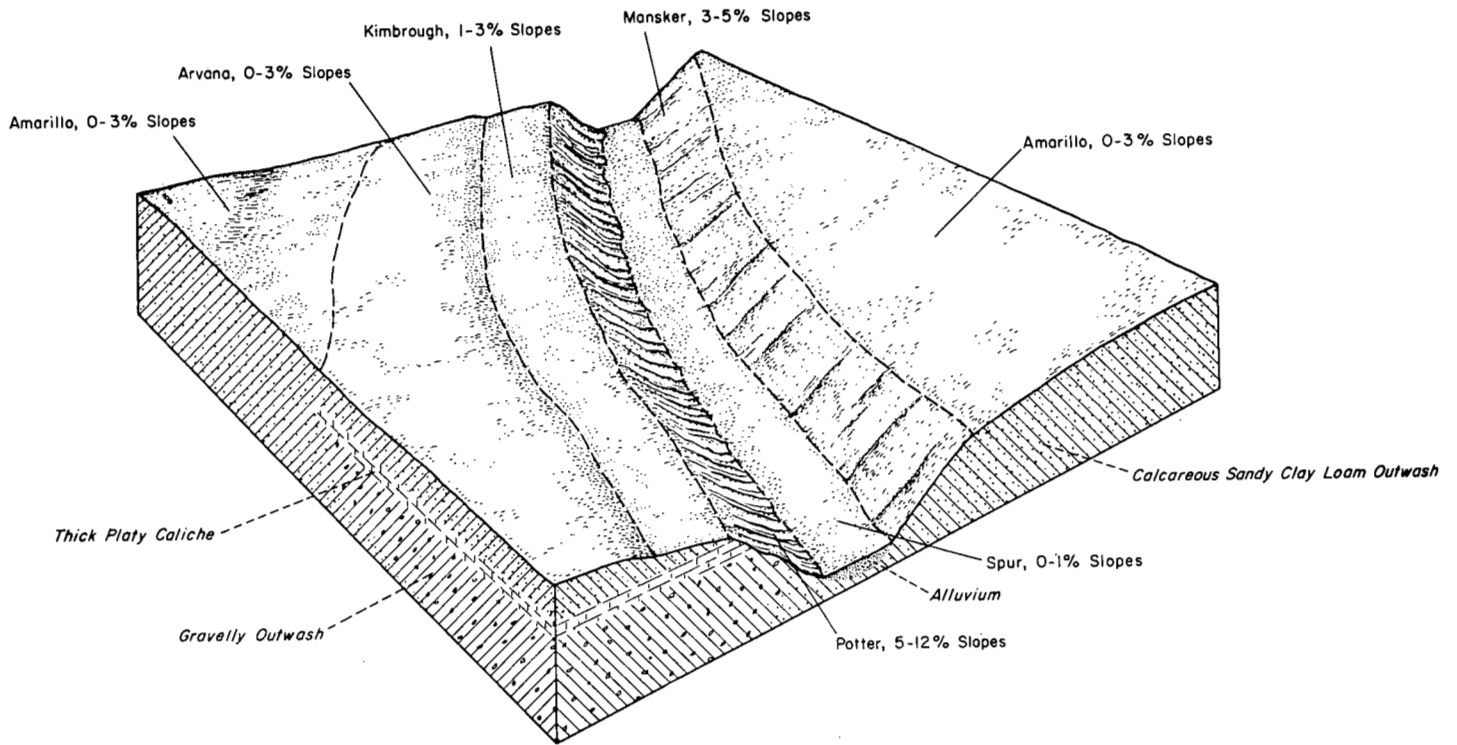


Figure 17.—Upper left: Soils on high plains developed from sandy parent material; lower left: Soils in a playa on high plains and associated soils on high plains



sociated soils; **upper right:** Soils in ancient drain on high plains and associated soils; **lower right:** Soils on caprock and associated and rolling plains.

The soils on the rolling plains have developed from two different kinds of parent material. These soils are east of and below the caprock. Most of the soils have developed from a thick alluvial mantle of outwash, 5 to 30 feet thick. This material is similar to that from which the soils on the high plains developed. Smaller areas of clayey soils have developed from the exposed Triassic Red Beds.

A few areas of cretaceous material are exposed on the caprock escarpment near the eastern edge of the county. This cretaceous material is in narrow bands in Stony rough land, Potter material. Only a little of the cretaceous material is exposed, and it has had little, if any, effect on the soils lying below.

Relief

Dawson County is a nearly level to very gently undulating constructional plain that has little dissection. The western part of the county is the most undulating, largely because eolian deposits of sand have been shifted and reworked by wind. Two relict drainageways, Sulphur Springs Draw and Dry Tobacco Draw, cross the county from northwest to southeast. They are shallow intermittent drains that seldom have water. Playas, or shallow lakes, are common, especially in the eastern part of the high plains. These lakes range in size from 2 to 40 acres or more. They provide the only drainage for most of the high-plains area.

The caprock escarpment is a distinct boundary between the high plains and the rolling plains (fig. 18; see also fig. 2). Although the rolling plains have developed a well-defined drainage pattern, the high plains have not.

Elevations range from 2,600 feet near Ackerly in the southeastern part of the county to 3,200 feet at Welch in the northwestern part. The high plains have a general southeasterly slope of about 10 feet to the mile. At the caprock, elevations change abruptly as much as 200 feet. The rolling plains are much more rolling and dissected than the high plains.

The nearly level relief of the high plains has resulted in a large proportion of zonal soils. Since the rolling plains have developed a drainage pattern and are more sloping, there is a large proportion of intrazonal soils. The steeply sloping draw slopes and the caprock escarpment are mostly occupied by azonal soils.

Time

The length of time that climate, living organisms, parent material, and relief have interacted has had a great effect in determining the kinds of soils that developed. Young soils have had little development. Their soil material has not been in place long enough for the formation of well-defined horizons that are genetically related. Soils on the bottom land and the eolian dunes that border the playas are of this kind. Soils on steep slopes have had the effects of soil formation destroyed by geologic erosion.

Soils that have been in place a long time and have approached equilibrium with their environment are considered mature or old. These soils show marked horizon differentiation. They generally are well drained and nearly level to gently sloping.

Classification

Soils are classified in orders, great soil groups, and series. The soil orders are zonal, intrazonal, and azonal.

The zonal order consists of soils that have distinct genetically related horizons that reflect the predominant influence of climate and living organisms. These soils have an A, B, C sequence of horizons.

The intrazonal soil order consists of soils having more or less well developed horizons that reflect a dominating influence of some local factor of relief or parent material over the normal influence of climate and living organisms.

The azonal order consists of soils that have little or no development of the soil profile. Their profile lacks development because of its youth, resistant parent material, or steep topography. Generally, azonal soils have a weak A₁ horizon.

A great soil group is a broad group of soils that have fundamental characteristics in common. This grouping is broader than the soil series and may be made up of many soil series. The great soil groups in Dawson County are the Reddish Chestnut, Brown, Calcisol, Grumusol, Lithosol, Regosol, and Alluvial.

A classification of all the soil series in Dawson County, according to their soil orders and great soil groups, is shown in the following list:

Zonal soils—	Azonal soils—
Reddish Chestnut soils:	Lithosols:
Abilene	Kimbrough
Amarillo	Potter
Arvana	Regosols:
Brownfield	Drake
Miles	Tivoli
Brown soil:	Vernon
Vona	Alluvial soil:
Intrazonal soils—	Spur
Calcisols:	
Arch	
Bippus	
Mansker	
Portales	
Zita	
Grumusol:	
Randall	



Figure 18.—The caprock escarpment.

Morphology

Table 10 is presented so that the genetic and morphologic relationship of the horizons in different soil types can be compared. A profile for a soil in each soil type in the county is described in the subsection, Descriptions of Soils.

The zonal Miles soils are not shown in table 10. They are very similar to the Amarillo soils except that they occur in the rolling plains and are underlain at a depth of many feet by Triassic Red Beds. The Vona soils have developed from sandy, calcareous materials and have an indistinct B horizon.

The intrazonal Arch soils have developed from highly calcified parent materials that, in many places, formed lake beds until very recent geologic times. Portales soils have developed from parent material similar to that of the Arch soils, but they are older than the Arch and have had more of the lime leached from the profile. The Zita soils are more developed than the Portales and Arch soils and, in places, have a small accumulation of clay in the AC horizon. This indicates that a weakly developed B horizon is forming. The Bippus soils have developed from materials similar to the parent materials of the Amarillo soils. They have not been in place long enough to develop distinct horizons.

The lack of development in the Mansker soils may be due to relief, age, or parent material. Theoretically, during a long period, Arch soils should develop into soils resembling Mansker soils, then into Portales, then Zita, and finally into the zonal Amarillo soils.

The azonal Drake soils are young. They formed from the eolian deposits from nearby playas. These deposits are very high in lime and have slopes steep enough to cause runoff. Potter soils are weakly developed because of the geologic erosion on the steep slopes. Tivoli soils are young, and their parent materials contain very little clay or minerals that are easily weathered. The Spur soils are on recent alluvium and, except for the A₁ horizon, show little horizon differentiation. Kimbrough soils have developed from a resistant, hard caliche and, therefore, are very shallow. Vernon soils have developed on slopes from very clayey materials.

General Nature of the Area

This section is prepared for those not familiar with the area. It contains subsections on climate, natural resources, and other subjects of general interest.

Climate

Dawson County has the warm-temperate, subhumid, continental climate that is characteristic of the southern part of the high plains. The average annual temperature is about 60°F., but temperature varies widely. The average annual precipitation is about 18.6 inches, but much of this falls during parts of the year when it is not very effective. High winds occur fairly often. The average growing season is long enough for most crops to mature.

Table 11 gives average monthly, seasonal, and annual temperatures and precipitation compiled from the records of the United States Weather Bureau station at Lamesa.

Although sudden, wide variations in temperature occur, extremes of temperature last only a short time. Rapidly moving early spring fronts are common. In April the highest temperature may be in the 90's one day, and the next day the temperature may fall to the 30's. The highest temperatures are in July and August. The average growing season extends from April 8 to November 2, a period of 208 days. Killing frosts, however, have occurred as late as April 25 and as early as October 20.

The average precipitation based on a 45-year record was 18.61 inches. Rainfall varied, however, from as little as 3.22 in 1917 to as much as 39.07 in 1941 (fig. 19). About 80 percent of the annual rainfall in this area occurs in the 7-month period from April through October. Consequently, it is difficult to grow enough cover crops in winter to control wind erosion. Crops that leave enough stubble to prevent erosion must be grown in the months of high rainfall.

Much of the precipitation in the county is ineffective. During July and August the average rainfall is relatively ineffective because most of it comes in local thunderstorms when the humidity is low and temperature and the rate of evaporation are high. The rainfall is more effective in September and October when it is cooler.

In table 12 are the results of studies made for a 40-year period, at Big Spring Field Station, to determine the effects of preseasonal precipitation and seasonal rainfall on yields of lint cotton. Big Spring is about 20 miles southeast of Dawson County. Preseasonal precipitation is the precipitation that falls from September 1 to April 30. Seasonal rainfall occurs from May 1 to August 31.

In the 3 years when seasonal rainfall was less than 3 inches, the annual yield of cotton lint was less than 30 pounds per acre. When seasonal rainfall was more than 6 inches, yields were never less than 95 pounds per acre. When seasonal rainfall was more than 9 inches, yields were never less than 140 pounds per acre.

In the 6 years when preseasonal precipitation was less than 5 inches, seasonal rainfall was less than 6 inches in 3 years and more than 6 inches in 3 years. This indicates a 50-50 chance that low preseasonal precipitation will be followed by high seasonal rainfall. In the 3 years when seasonal rainfall was less than 6 inches and pre-seasonal precipitation was less than 5 inches, yields of cotton lint were less than 35 pounds per acre. In only 1 year when preseasonal precipitation was more than 5 inches was the seasonal rainfall less than 3 inches. This indicates that the chance is very low that pre-seasonal precipitation of more than 5 inches will be followed by seasonal rainfall of less than 3 inches.

In the 40-year period shown in table 12, seasonal rainfall was less than 6 inches 10 times and more than 6 inches 30 times. Preseasonal precipitation was more than 9 inches 20 times and less than 9 inches 20 times.

TABLE 10.—*Topography and underlying material of important soil types, arranged*

ZONAL			
Great soil group and soil type	Relief	Underlying material	Horizon
Reddish Chestnut soils: Amarillo fine sandy loam-----	Upland; nearly level to gently sloping, convex slopes.	About 20 percent of the C _{ca} horizon consists of soft and hard concretions of calcium carbonate.	A ₁ ----- B ₂ ----- B ₃ ----- C _{ca} ----- C-----
Arvana fine sandy loam-----	On gently sloping, convex ridgetops and smooth or gently undulating upland.	At depths of 20 to 36 inches hard, platy pisolitic caliche many feet thick.	A ₁ ----- B ₂₁ ----- B ₂₂ -----
Brownfield fine sand, thin surface.	Long, gentle slopes with billowy micro-relief.	C horizon ranges from light sandy clay loam to loamy fine sand; may be underlain by hard caliche.	A ₁ ----- A ₂₁ ----- B ₂₂ ----- C-----
INTRAZONAL			
Calcisols: Mansker clay loam-----	Nearly level to gently sloping; a few level areas.	C _{ca} horizon contains many concretions and is indurated in places. C horizon is soft white earth in many places.	A ₁ ----- AC----- C _{ca} ----- C-----
Portales fine sandy loam-----	Nearly level areas that appear to be ancient lake beds or drainageways.	C _{ca} horizon contains concretions that make up as much as 30 percent of the horizon; is slightly indurated in some places.	A ₁ ----- AC----- C _{ca} ----- C-----
Grumusol: Randall clay-----	Level floors of playa lakes that remain under water for long periods; gilgai microrelief is common.	C horizon is stiff and plastic and has some mottles; D horizon occurs at depths of many feet and may be pink sandy clay loam.	A ₁ ----- AC-----
AZONAL			
Lithosol: Potter soils ² -----	Steeply sloping into ancient drains or along caprock escarpment.	C horizon is soft chalky earth many feet thick; in some places is indurated in upper part.	A ₁ -----
Regosol: Tivoli fine sand-----	Undulating to rolling and has large areas with dunelike topography; most dunes are stabilized.	C horizon is loose, sterile sand many feet thick.	A ₁ ----- C-----

¹ Structure not determined.² Potter soils are extremely variable. Characteristics given are for a fine sandy loam.

in higher categories, and the texture, color, structure, and reaction of their horizons

ZONAL—Continued

Depth	Texture	Color	Structure	Reaction
<i>Inches</i>				
0-14	Fine sandy loam.....	Reddish brown (5YR 5/3)....	Structureless.....	Noncalcareous.
14-32	Sandy clay loam.....	Reddish brown (5YR 5/4)....	Moderate, coarse, prismatic and weak, subangular blocky.	Noncalcareous.
32-44	Sandy clay loam.....	Reddish brown (5YR 6/6)....	Weak, subangular blocky....	Slightly calcareous.
44-56	Sandy clay loam.....	Pink (5YR 7/4).....	(1).....	Strongly calcareous.
56-60	Sandy clay loam.....	Pink (5YR 7/4).....	(1).....	Strongly calcareous.
0-6	Fine sandy loam.....	Dark brown (7.5YR 4/4)....	Structureless.....	Noncalcareous.
6-14	Sandy clay loam.....	Reddish brown (5YR 4/3)....	Weak, coarse, prismatic and weak, subangular blocky.	Noncalcareous.
14-26	Sandy clay loam.....	Yellowish red (5YR 4/3)....	Moderate, coarse, prismatic and moderate, subangular blocky.	Noncalcareous.
0-14	Fine sand.....	Brown (7.5YR 5/4).....	Structureless.....	Noncalcareous.
14-34	Sandy clay loam.....	Yellowish red (5YR 5/6)....	Moderate, coarse, prismatic and moderate, subangular blocky.	Noncalcareous.
34-54	Sandy clay loam.....	Red (2.5YR 4/6).....	Weak, coarse, prismatic and subangular blocky.	Noncalcareous.
54-72	Fine sandy loam.....	Yellowish red (5YR 5/8)....	(1).....	Noncalcareous.

INTRAZONAL—Continued

0-8	Light clay loam.....	Brown (10YR 5/3).....	Weak, subangular blocky....	Slightly calcareous.
8-16	Clay loam.....	Grayish brown (10YR 5/2)....	Weak, prismatic and weak, subangular blocky.	Strongly calcareous.
16-26	Clay loam.....	White to pinkish white (5YR 3/2).	(1).....	Very strongly calcareous.
26+	Clay loam.....	Pink (7.5YR 8/4).....	(1).....	Very strongly calcareous.
0-12	Fine sandy loam.....	Brown (10YR 5/3).....	Structureless.....	Slightly calcareous.
12-30	Sandy clay loam.....	Pale brown (10YR 6/3)....	Weak, subangular blocky and granular.	Strongly calcareous.
30-48	Clay loam.....	Very pale brown (10YR 7/3)...	(1).....	Very strongly calcareous.
48+	Sandy clay loam.....	Very pale brown (10YR 7/3)...	(1).....	Very strongly calcareous.
0-15	Clay.....	Dark gray (10YR 4/1).....	Strong, fine, blocky.....	Noncalcareous to strongly calcareous.
15-46	Clay.....	Gray (10YR 5/1).....	Strong, fine, blocky.....	Strongly calcareous.

AZONAL—Continued

0-8	Fine sandy loam.....	Grayish brown (10YR 5/2)....	Weak, subangular blocky....	Strongly calcareous.
0-8	Fine sand.....	Brown (10YR 5/3).....	Structureless.....	Noncalcareous.
8-72	Fine sand.....	Pale brown (10YR 6/3)....	Structureless.....	Noncalcareous.

TABLE 11.—*Temperature and precipitation at Lamesa, Dawson County, Texas*
[Elevation, 2,975 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1917)	Wettest year (1941)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December-----	43. 2	84	3	0. 91	0. 00	0. 00	0. 9
January-----	42. 0	83	0	. 52	. 21	. 56	1. 2
February-----	46. 1	87	-12	. 78	. 31	. 94	. 8
Winter-----	43. 8	87	-12	2. 21	. 52	1. 50	2. 9
March-----	53. 5	95	7	. 77	. 10	3. 20	. 8
April-----	62. 1	98	23	1. 49	. 52	3. 96	. 1
May-----	70. 4	103	37	2. 06	. 36	9. 27	(³)
Spring-----	62. 0	103	7	4. 32	. 98	16. 43	. 9
June-----	78. 6	108	46	2. 35	. 00	1. 08	(³)
July-----	80. 7	111	54	2. 08	. 23	1. 93	(³)
August-----	80. 2	110	52	2. 16	. 19	2. 62	(³)
Summer-----	79. 8	111	46	6. 59	. 42	5. 63	(³)
September-----	73. 4	105	37	2. 42	1. 11	2. 88	0
October-----	63. 7	101	28	2. 28	. 00	12. 50	(³)
November-----	51. 4	91	10	. 79	. 19	. 13	. 1
Fall-----	62. 8	105	10	5. 49	1. 30	15. 51	. 1
Year-----	62. 1	111	-12	18. 61	3. 22	39. 07	3. 9

¹ Average temperature based on a 28-year record, through 1955; highest temperature on a 22-year record and lowest temperature on a 21-year record, through 1952.

² Average precipitation based on a 45-year record, through 1955; wettest and driest years based on a 45-year record, in the period 1910-55; snowfall based on a 41-year record, through 1952.

³ Trace.

TABLE 12.—*Effect of different combinations of preseasonal precipitation and seasonal rainfall on yields of cotton lint at Big Spring, Tex.,¹ 1916-1955*

Pre-seasonal precipitation	Seasonal rainfall and yields of cotton lint				Number of years rainfall was more than 6 inches	Average yield of cotton lint when rainfall was more than 6 inches
	Number of years rainfall was less than 3 inches	Average yield of cotton lint when rainfall was less than 3 inches	Number of years rainfall was 3 to 6 inches	Average yield of cotton lint when rainfall was 3 to 6 inches		
Inches		<i>l.b. per acre</i>		<i>l.b. per acre</i>		<i>l.b. per acre</i>
2 to 5----	2	0	1	32	3	258
5 to 9----	0	0	2	206	12	255
More than 9----	1	29	4	188	15	311

¹ BURNETT, EARL AND MOLDENHAUER, W. C., USING RAINFALL RECORDS AS GUIDES TO PREDICT YIELDS OF COTTON ON DRYLANDS OF THE HIGH AND ROLLING PLAINS OF TEXAS, Texas Agricultural Experiment Station Misc. Pub. 223, 1957.

Early History, Development, and Population

The Comanche Indians lived in what is now Dawson County until as late as 1870. Their favorite campsites were along the caprock escarpment, where there were many fresh-water springs. Above and west of the escarpment, thousands of buffalo ranged the vast, treeless, practically waterless plains. Quail and antelope were also plentiful.

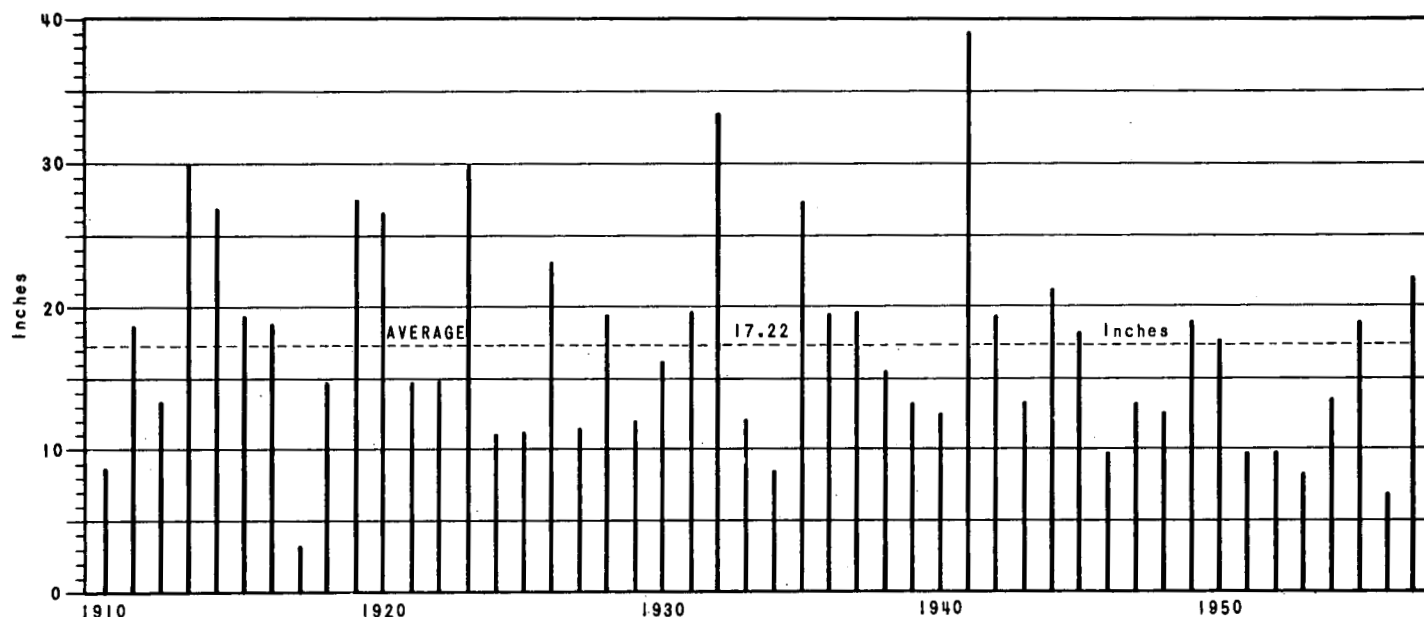


Figure 19.—Annual rainfall in Dawson County, Tex., from 1910 through 1957.

The white hunter of buffalo arrived in 1874. A little later ranchers settled in the area. In 1878, a huge ranch was established, and this ranch along with three others covered the entire county until 1900. The early ranchers acquired the use of State school land for grazing by paying 3 to 5 cents per acre. This lease arrangement and the windmill, which tapped underground water, helped cattle ranching.

In 1900, the State Legislature passed an act that enabled small operators to buy 4 sections, or 2,560 acres, at \$1 to \$2 per acre. The purchaser could pay off his mortgage at 3 percent interest in 40 years. This legislation caused the first appreciable increase in population. It also caused an increase in farming and a decrease in ranching.

In 1905, Dawson County was organized. It was named for Nicholas Dawson, who fought the Battle of San Jacinto. Scarcely 200 people lived in the area when the county was organized.

In 1910, the railroad came to Dawson County and with it a second increase in population. This increase was greater than the first, but by 1915, the county was still very sparsely populated. Especially good crop yields in 1914 and 1915 caused another influx of settlers, and, in 1916, about 1,000 people lived in the county. From 1916 to 1950, the increase in population was steady. In 1930, there were 13,573 people in the county; in 1940, 15,367; and in 1950, 19,113.

Natural Resources

Soil is the most important natural resource in Dawson County. The strong, native grasses that grow on the soil attracted the first settlers, who established ranches. A fertile soil developed under the grass, and later settlers cultivated the soil. Good yields of cotton, sorghum, and vegetables encouraged the early agricultural development.

Oil wells were first drilled in 1937. Some stone is quarried. In 1954, the oil, gas, and stone produced in the county were valued at nearly 8 million dollars. The county has about 480 oil and gas wells.

Enough underground water to supply livestock can be obtained in most of the high-plains area. This water is at depths of 100 to 150 feet. Many places in the high plains also have enough water available to irrigate crops. In the rolling plains, underground water is scarce, but enough water to supply livestock can be impounded. In 1954, 21,171 acres were irrigated in the county. Harvested cropland made up 20,207 acres of the irrigated land, and irrigated pasture made up the rest. The irrigated area in the county is shown in figure 20.

The only game birds that live in the county are blue quail, bobwhite quail, doves, and very few prairie chickens. Migratory ducks are plentiful in fall if the

playas contain water. The larger range areas have been restocked with a few antelope, which are thriving.

Agriculture

In the early days of settlement, most of the county was used for range. Only a small acreage was in cultivated crops. In recent years, however, much of the rangeland has been converted to dryland and irrigated farms.

Farmers began to use tractors extensively in the 1930's. The size of the average farm increased from 238.4 in 1930 to 604.3 acres in 1954. Also, the number of horses and mules on farms decreased from 11,152 in 1930 to 297 in 1954.

Crops

Table 13 gives the acreage of principal crops grown in Dawson County in stated years. Although sorghum is grown on a larger acreage than any other crop, cotton is the main cash crop. Some wheat, vegetables, and fruit are also grown.

TABLE 13.—*Acreage of the principal crops in stated years*

Crop	1939	1949	1954
Sorghum for all purposes except sirup.....	<i>Acres</i> 171, 901	<i>Acres</i> 77, 580	<i>Acres</i> 225, 145
Harvested for grain.....	110, 183	69, 922	208, 819
Hogged or grazed.....	—	7, 658	14, 739
Cut for silage.....	61, 718	—	1, 587
Cotton harvested.....	85, 390	300, 534	213, 276
Wheat threshed or combined..	240	3, 137	1, 163

Livestock

Table 14 shows that there has been a decline in livestock of all kinds since 1940.

TABLE 14.—*Number of livestock on farms in stated years*

Livestock	1940	1950	1954
Cattle and calves.....	<i>Number</i> ¹ 17, 183	<i>Number</i> 9, 539	<i>Number</i> 10, 907
Milk cows.....	3, 501	2, 308	1, 216
Hogs and pigs.....	² 4, 931	3, 141	2, 866
Sheep and lambs.....	³ 9, 114	5, 362	5, 655
Chickens.....	² 177, 691	² 83, 908	² 69, 550

¹ Over 3 months old.

² Over 4 months old.

³ Over 6 months old.

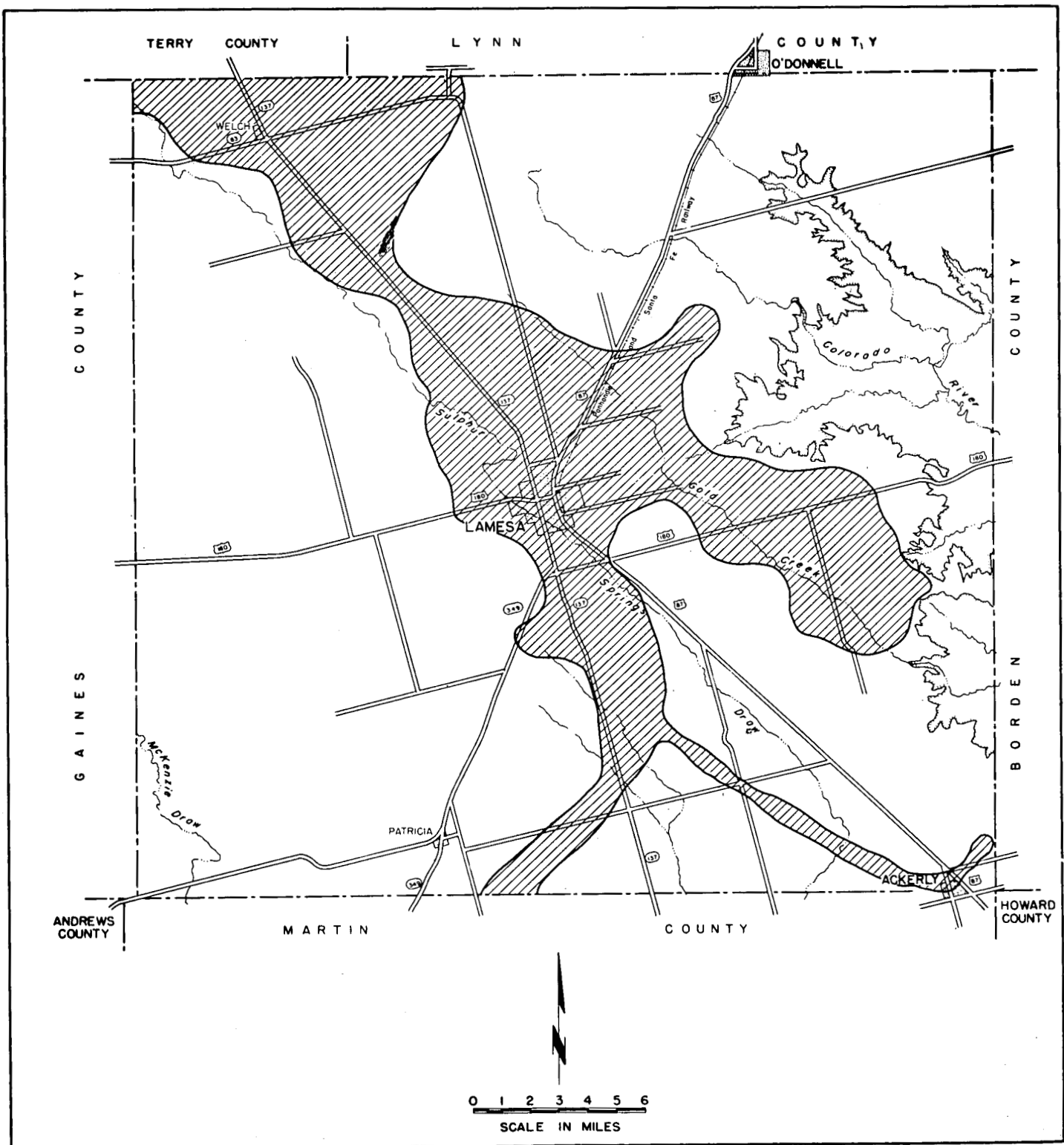


Figure 20.—Irrigated area in Dawson County shown by shading.

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Supplemental Nutrition Assistance Program

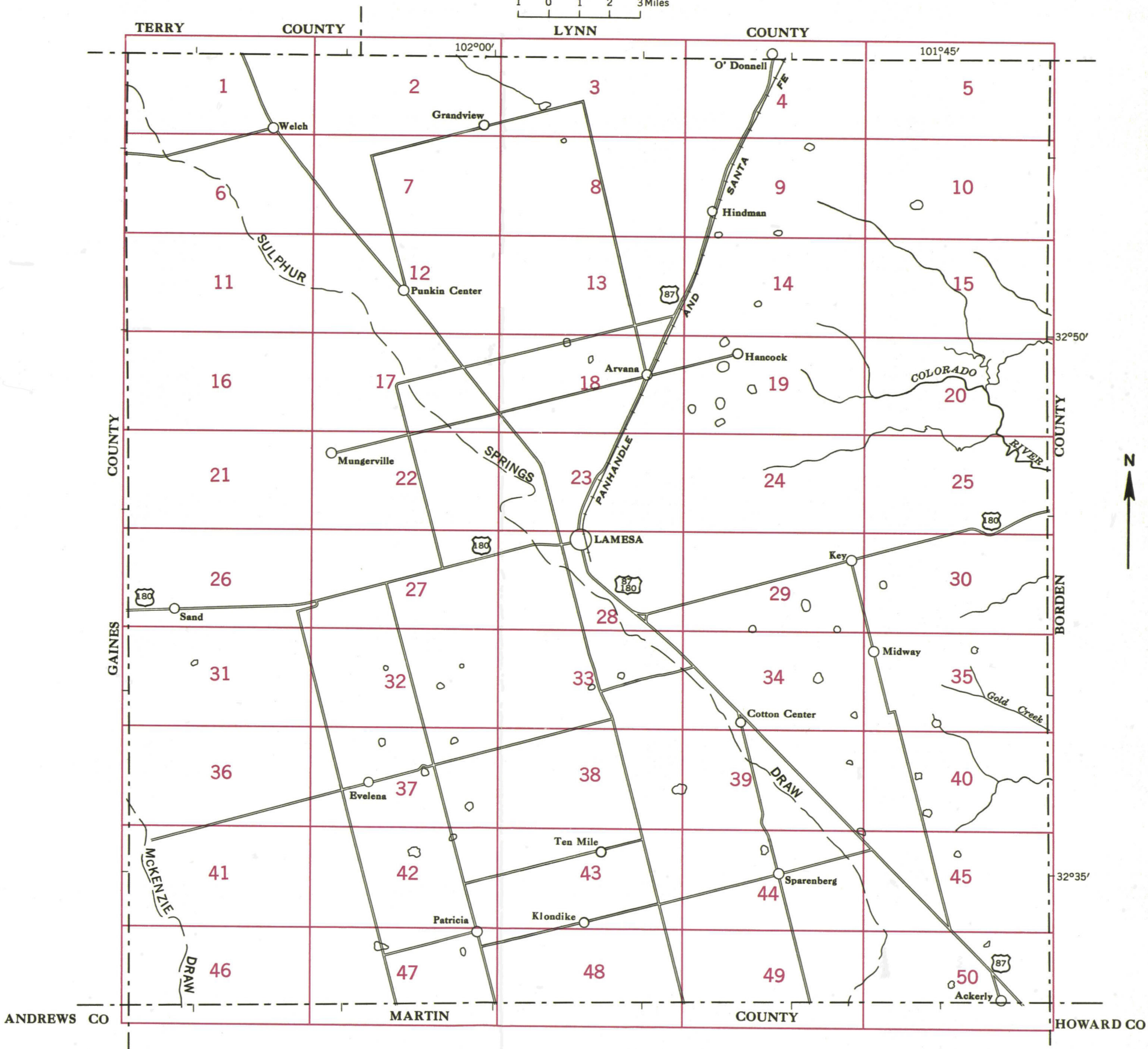
For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (<http://directives.sc.egov.usda.gov/33085.wba>).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (<http://directives.sc.egov.usda.gov/33086.wba>).

INDEX TO MAP SHEETS DAWSON COUNTY, TEXAS

Scale
1 0 1 2 3 Miles



SOIL LEGEND

Each soil symbol consists of letters or a combination of letters and numbers. The first capital letter is the initial of the soil series name. The second capital letter, if there is one, shows the class of slope and is given wherever slope forms part of the soil name. Some of the soils for which no slope letter is given are nearly level; some, such as stony rough land, Potter material, have a range of slope.

SYMBOL	NAME
AbA	Abilene clay loam, 0 to 1 percent slopes
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes
AnA	Amarillo sandy clay loam, 0 to 1 percent slopes
AnB	Amarillo sandy clay loam, 1 to 3 percent slopes
ArA	Arch fine sandy loam, 0 to 1 percent slopes
AsB	Arch loamy fine sand, 0 to 3 percent slopes, overblown
AvA	Arvana fine sandy loam, 0 to 1 percent slopes
AvB	Arvana fine sandy loam, 1 to 3 percent slopes
AxB	Arvana fine sandy loam, shallow, 0 to 3 percent slopes
AyB	Arvana loamy fine sand, 0 to 3 percent slopes
BcA	Bippus clay loam, 0 to 1 percent slopes
BcB	Bippus clay loam, 1 to 3 percent slopes
BcC	Bippus clay loam, 3 to 5 percent slopes
BfB3	Brownfield fine sand, 0 to 3 percent slopes, eroded
BkB	Brownfield fine sand, thick surface, 0 to 3 percent slopes
BnB	Brownfield fine sand, thin surface, 0 to 3 percent slopes
DfB	Drake fine sandy loam, 1 to 3 percent slopes
DrC	Drake soils, 3 to 5 percent slopes
KmC	Kimbrough soils, 1 to 5 percent slopes
MaA	Mansker clay loam, 0 to 1 percent slopes
MaB	Mansker clay loam, 1 to 3 percent slopes
MaC	Mansker clay loam, 3 to 5 percent slopes
MfA	Mansker fine sandy loam, 0 to 1 percent slopes
MfB	Mansker fine sandy loam, 1 to 3 percent slopes
MfC	Mansker fine sandy loam, 3 to 5 percent slopes
MsA	Miles sandy clay loam, 0 to 1 percent slopes
MsB	Miles sandy clay loam, 1 to 3 percent slopes
PcA	Portales clay loam, 0 to 1 percent slopes
PcB	Portales clay loam, 1 to 3 percent slopes
PfA	Portales fine sandy loam, 0 to 1 percent slopes
PfB	Portales fine sandy loam, 1 to 3 percent slopes
PsG	Potter soils, 8 to 30 percent slopes
Rc	Randall clay
Ro	Randall fine sandy loam, overblown
Sc	Spur clay loam
Sf	Spur fine sandy loam
Sr	Stony rough land, Potter material
Tv	Tivoli fine sand
VeD	Vernon soils, 1 to 8 percent slopes
VoB	Vona loamy fine sand, 0 to 3 percent slopes
ZfA	Zita fine sandy loam, 0 to 1 percent slopes

WORKS AND STRUCTURES

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Abandoned	-----
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R. R. under	-----
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Levee	-----
Tank	-----
Oil well	-----
Windmill	-----
Cotton gin	-----

CONVENTIONAL SIGNS

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Township, U. S.	-----
Section line, corner	-----
City (corporate)	-----
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DRAINAGE	
Streams	
Perennial	-----
Intermittent, unclass.	-----
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Not crossable with tillage implements	-----
Canals and ditches	-----
Lakes and ponds	-----
Perennial	-----
Intermittent	-----
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Springs	-----
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Bedrock	-----
Other	-----
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Not crossable with tillage implements	-----
Contains water most of the time	-----

SOIL SURVEY DATA

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Chert fragments	-----
Clay spot	-----
Sand spot	-----
Areas of high lime	-----
Line drift (dune)	-----
Erosion	
Uneroded spot	U
Sheet, moderate	S
Sheet, severe	SS
Gully, moderate	G
Gully, severe	GG
Sheet and gully, moderate	SG
Wind, moderate	-----
Wind, severe	-----
Blowout	-----
Wind hummock	-----
Overblown soil	-----
Gullies	-----
Areas of alkali and salts	
Strong	A
Moderate	M
Slight	S
Free of toxic effect	F
Sample location	26
Saline spot	-----

Soils surveyed 1956-1957 by Dupree Sanders, Kelly M. Templeton, Billy J. Wagner, Clifford J. Novosad, Horace E. Mitchell, and William M. Miller, Soil Conservation Service.
Correlation by Harvey Oakes, Soil Conservation Service.

Soil map constructed 1959 by Cartographic Division, Soil Conservation Service, USDA, from 1951 aerial photographs. Controlled mosaic based on Texas plane coordinate system, north central zone, Lambert conformal conic projection, 1927 North American datum.



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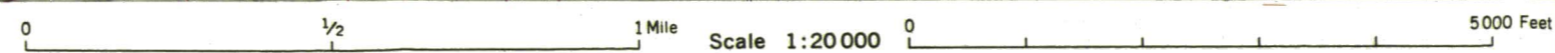
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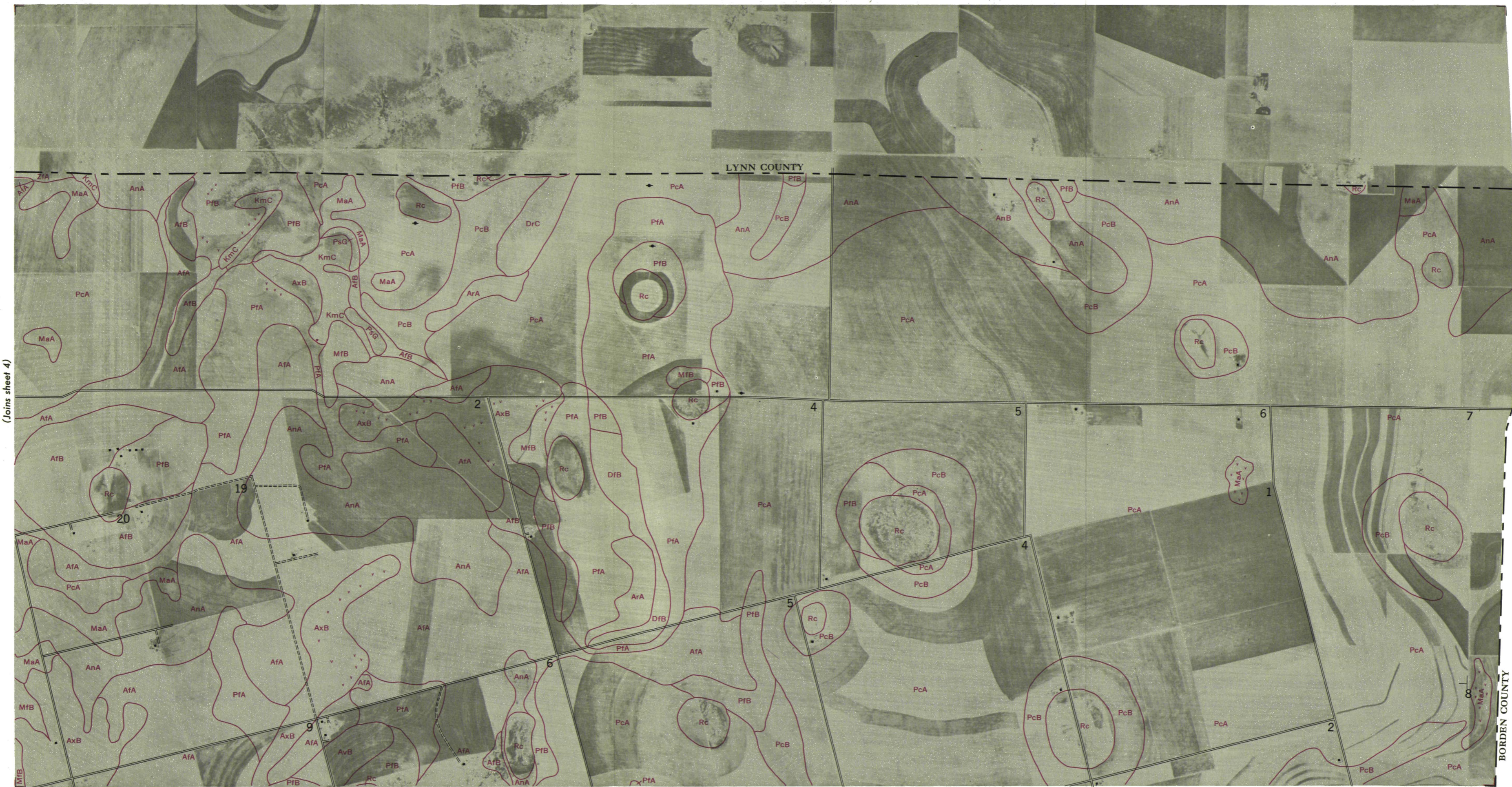
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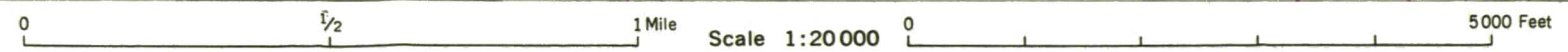
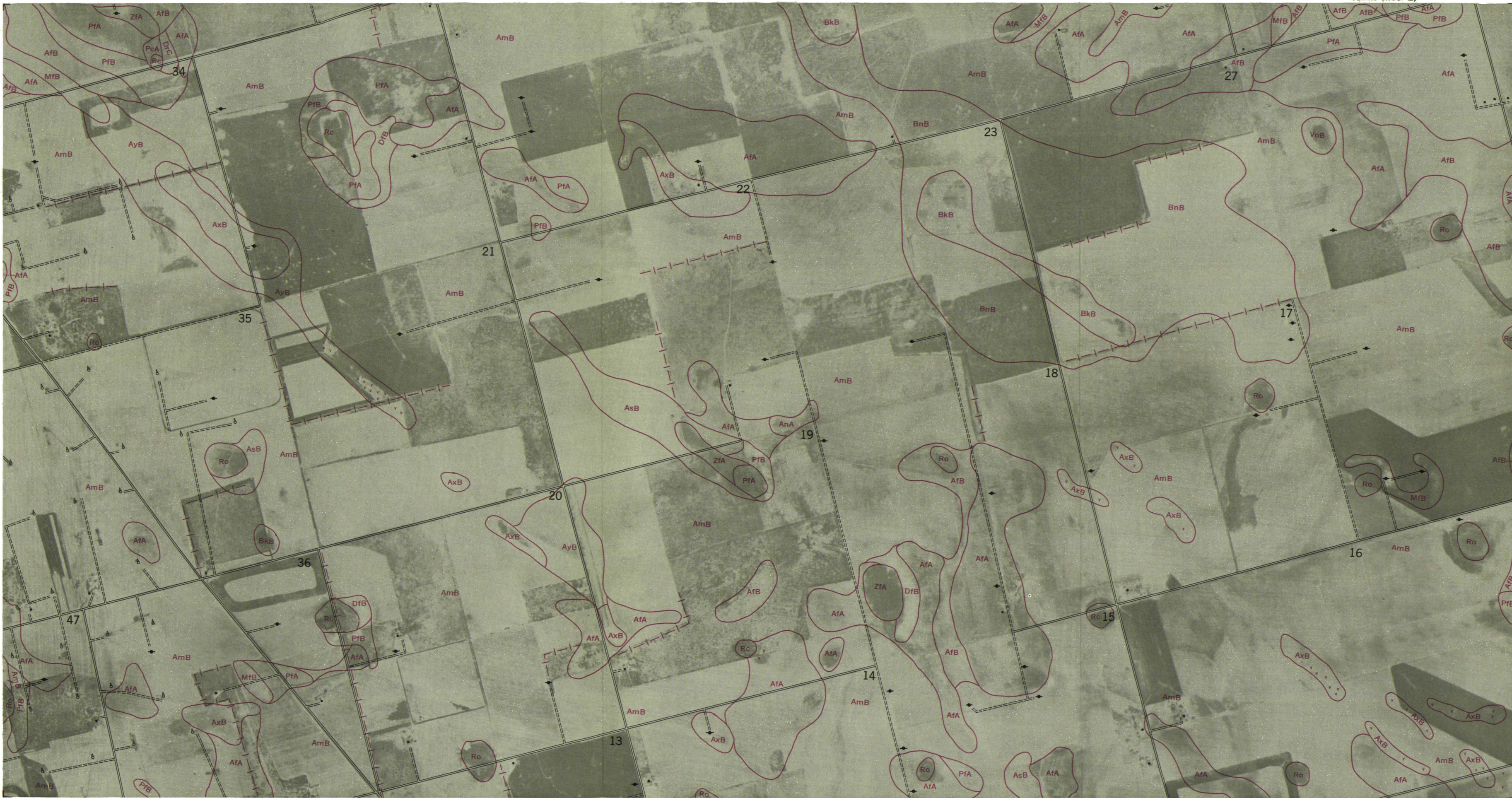


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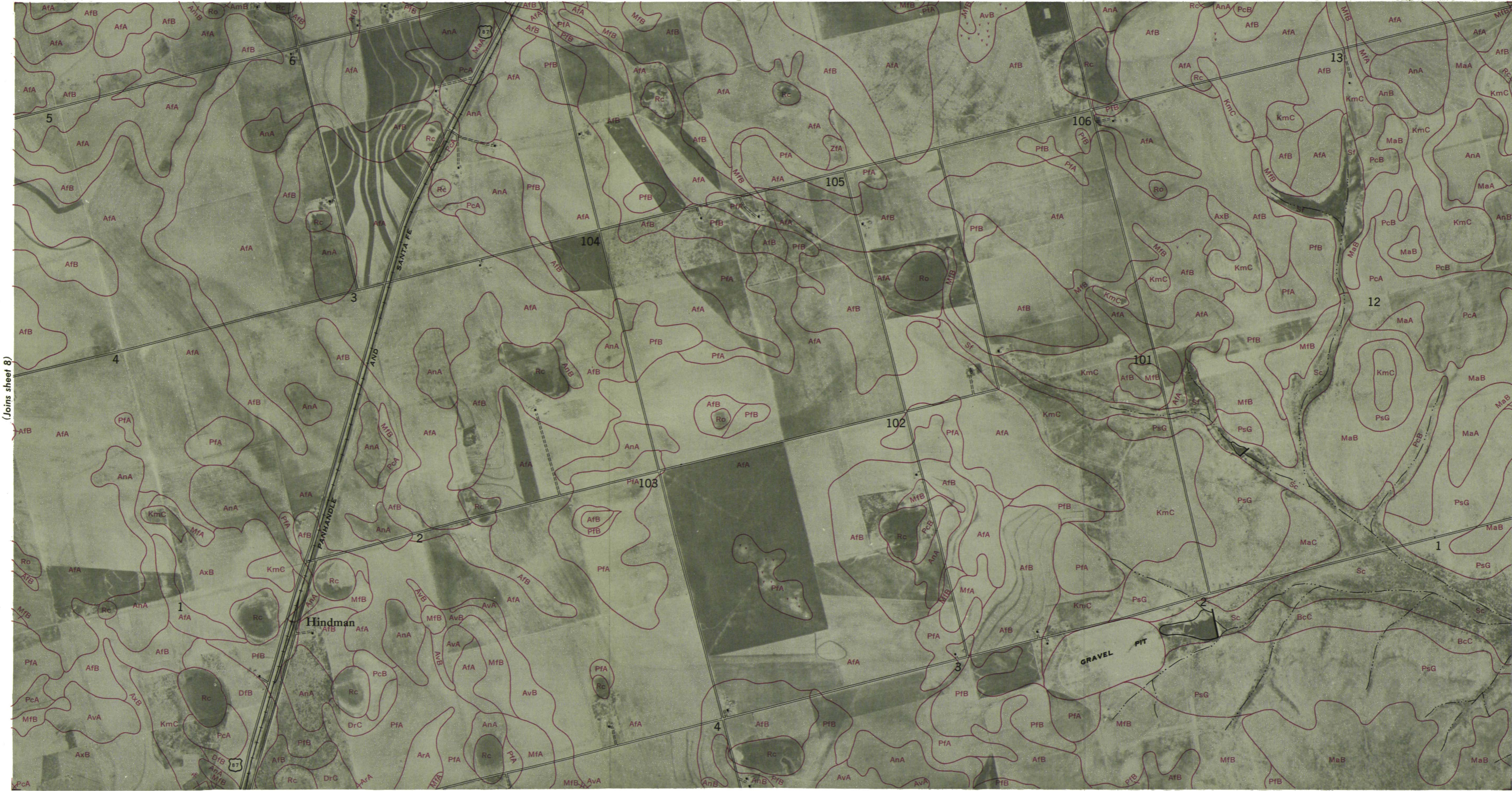
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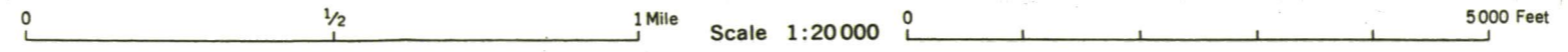
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BORDEN COUNTY





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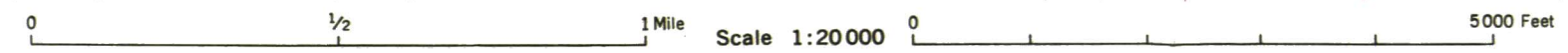


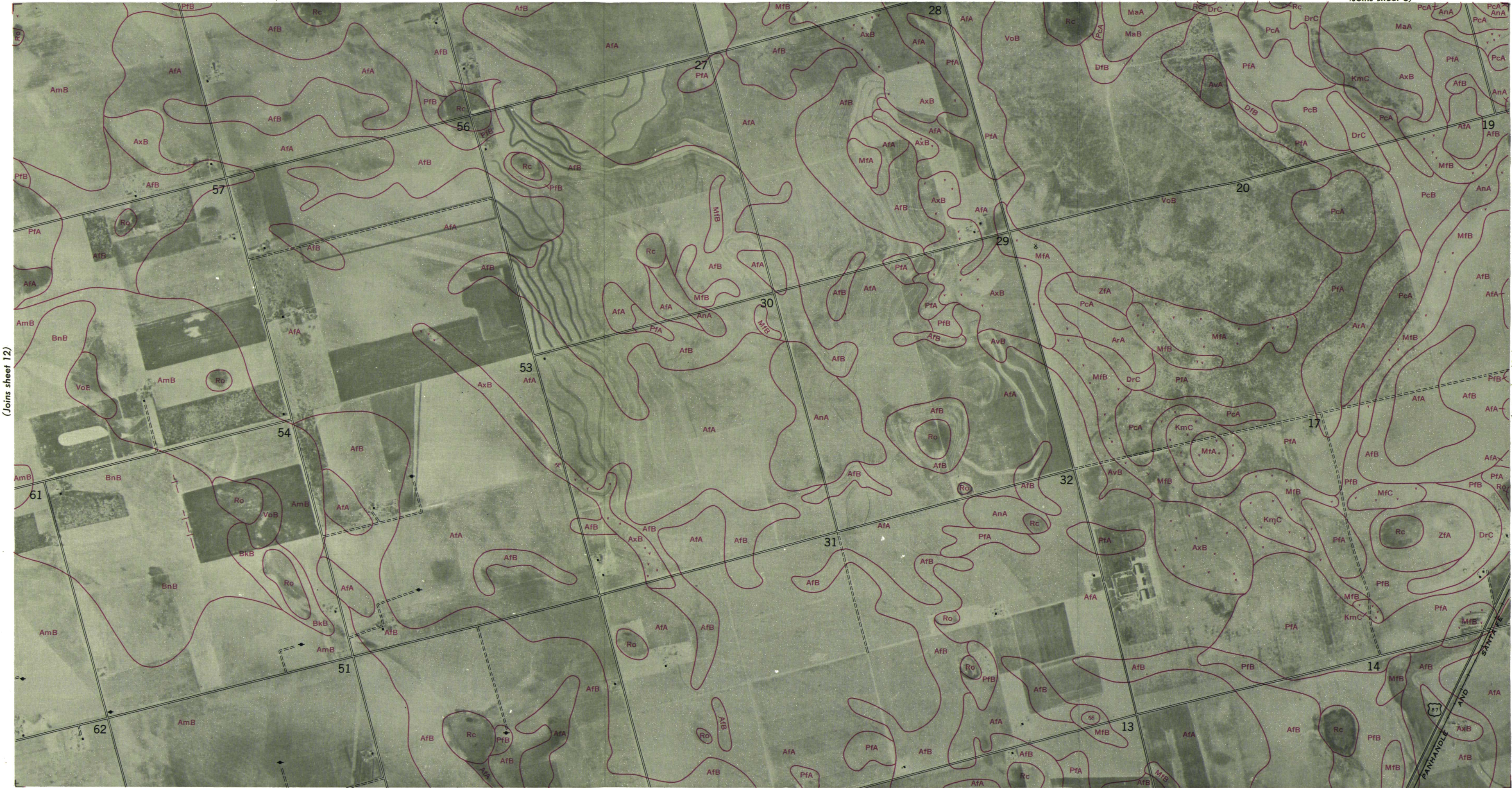
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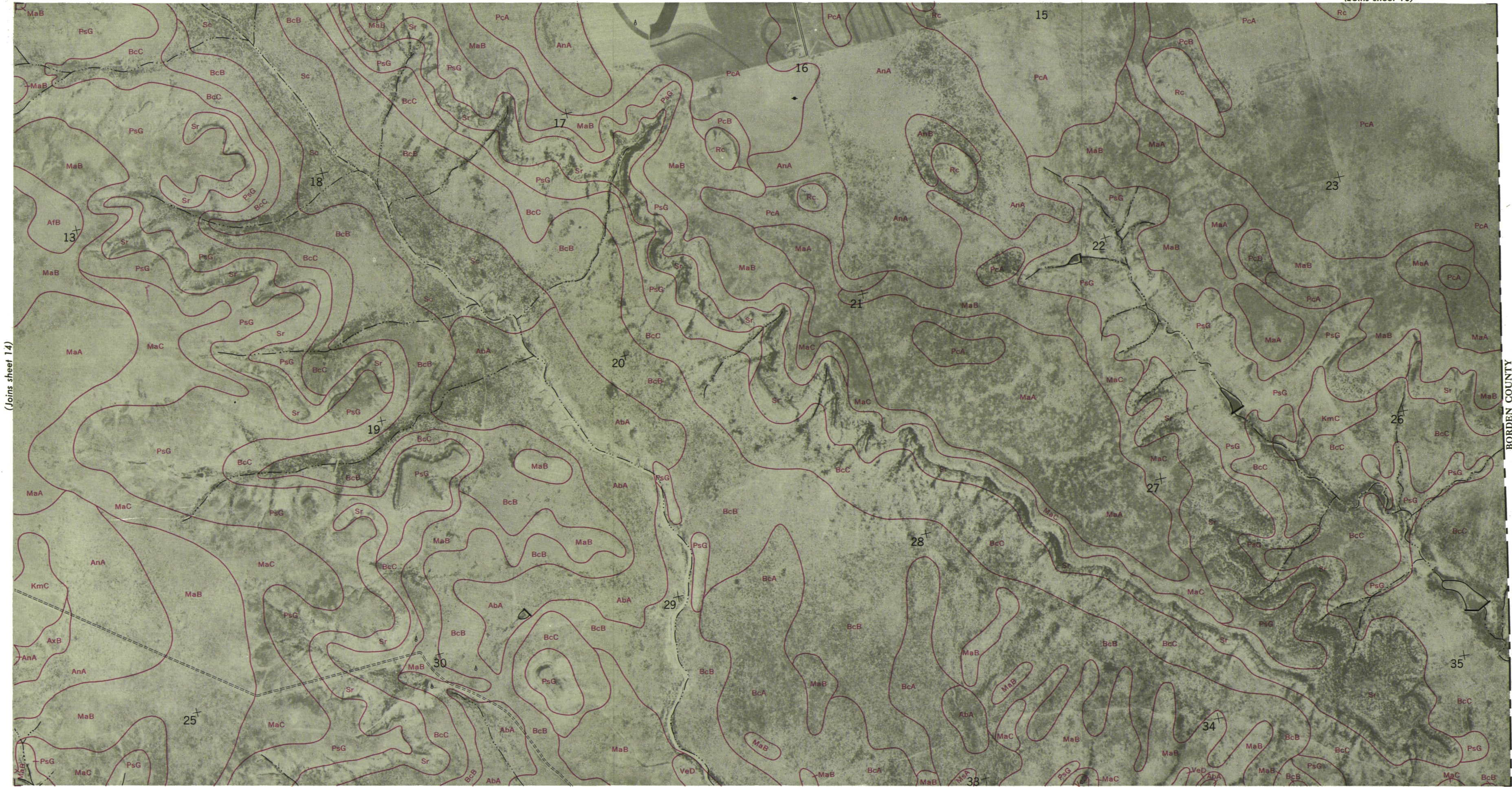
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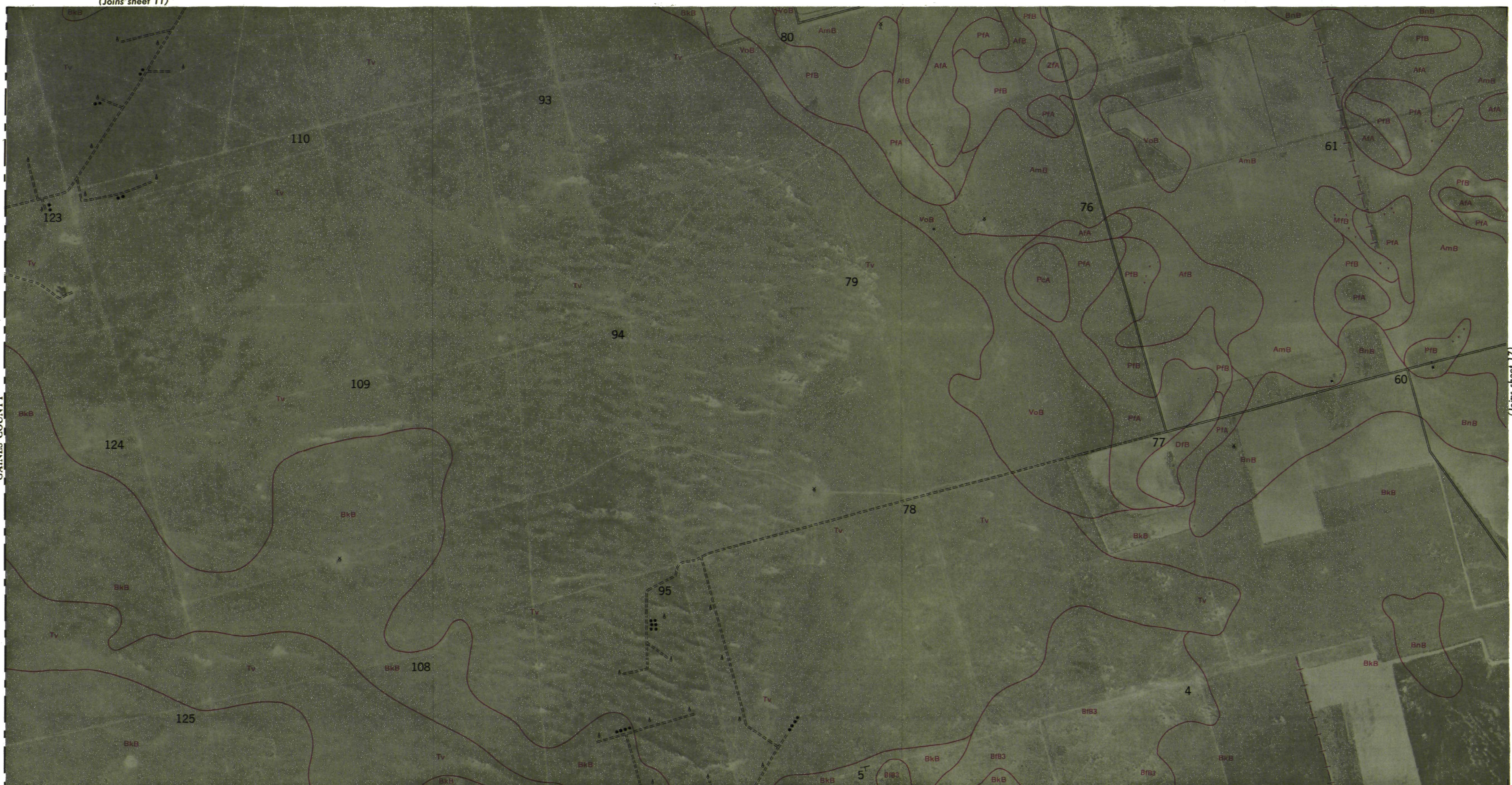
BORDEN COUNTY

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GAINES COUNTY

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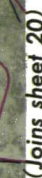


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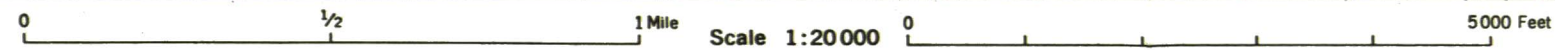
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BORDEN COUNTY



GAINES COUNTY



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Mungerville

SULPHUR

SPRINGS

DRAW

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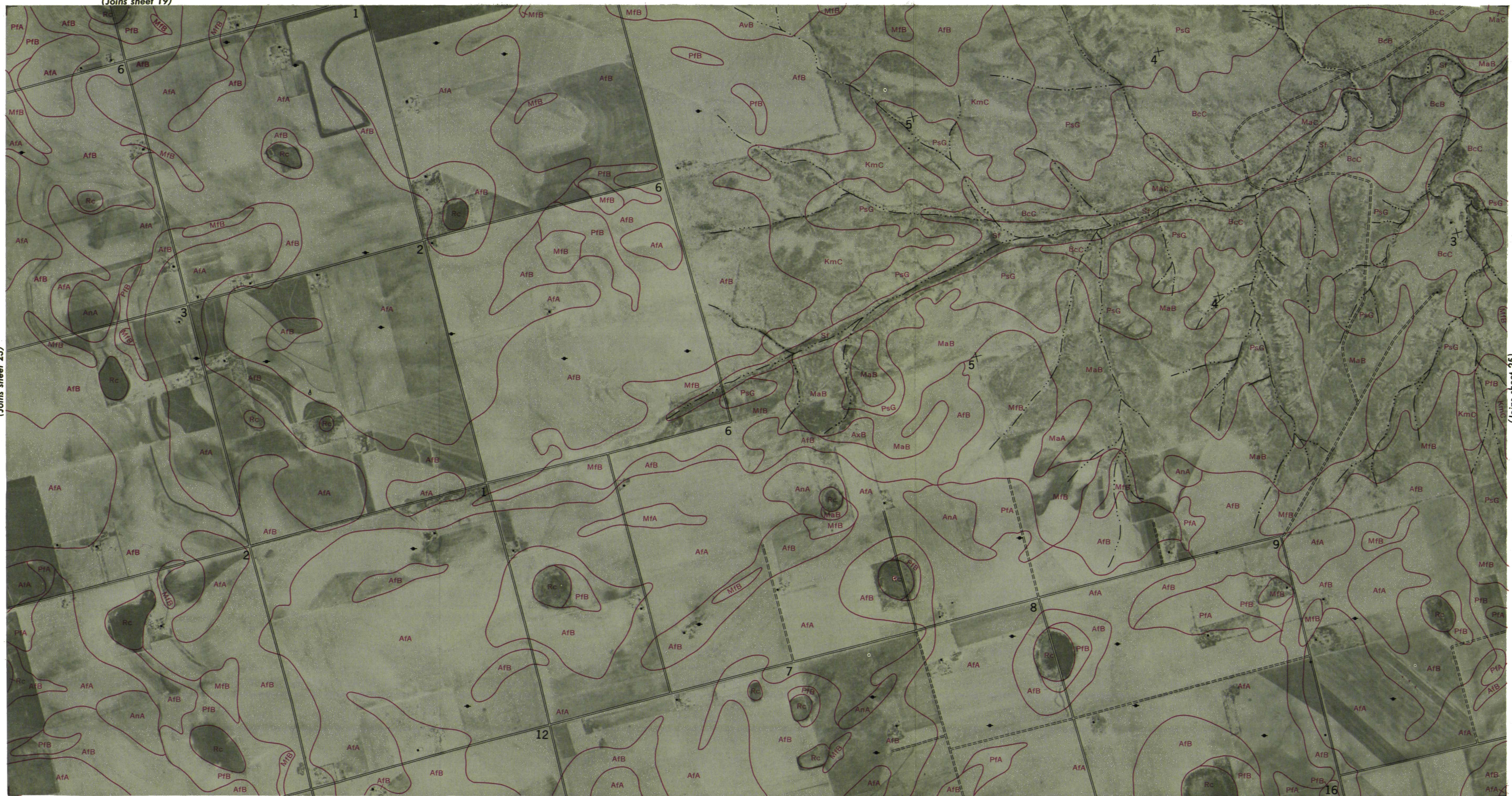
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BORDEN COUNTY

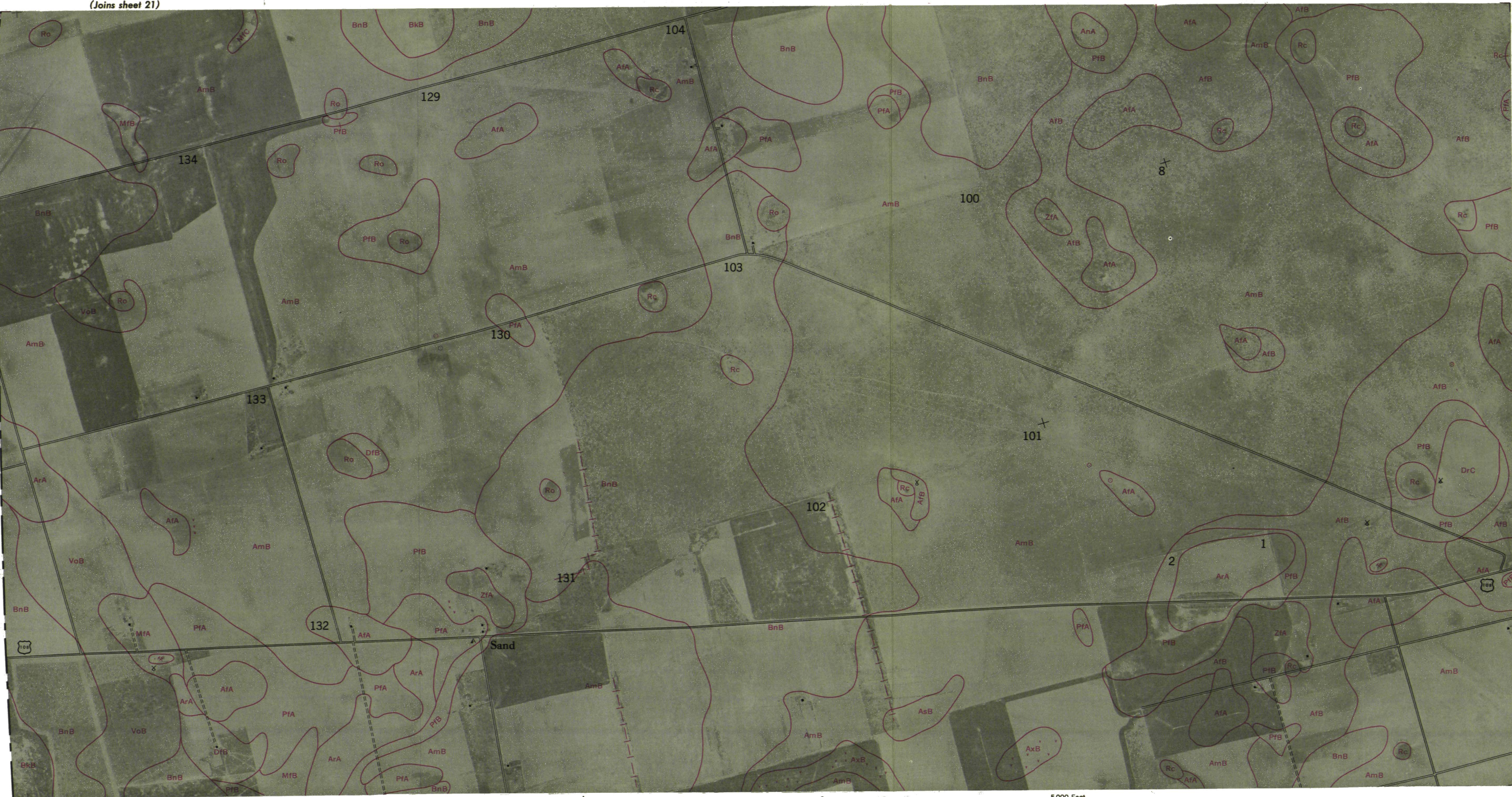
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GAINES COUNTY



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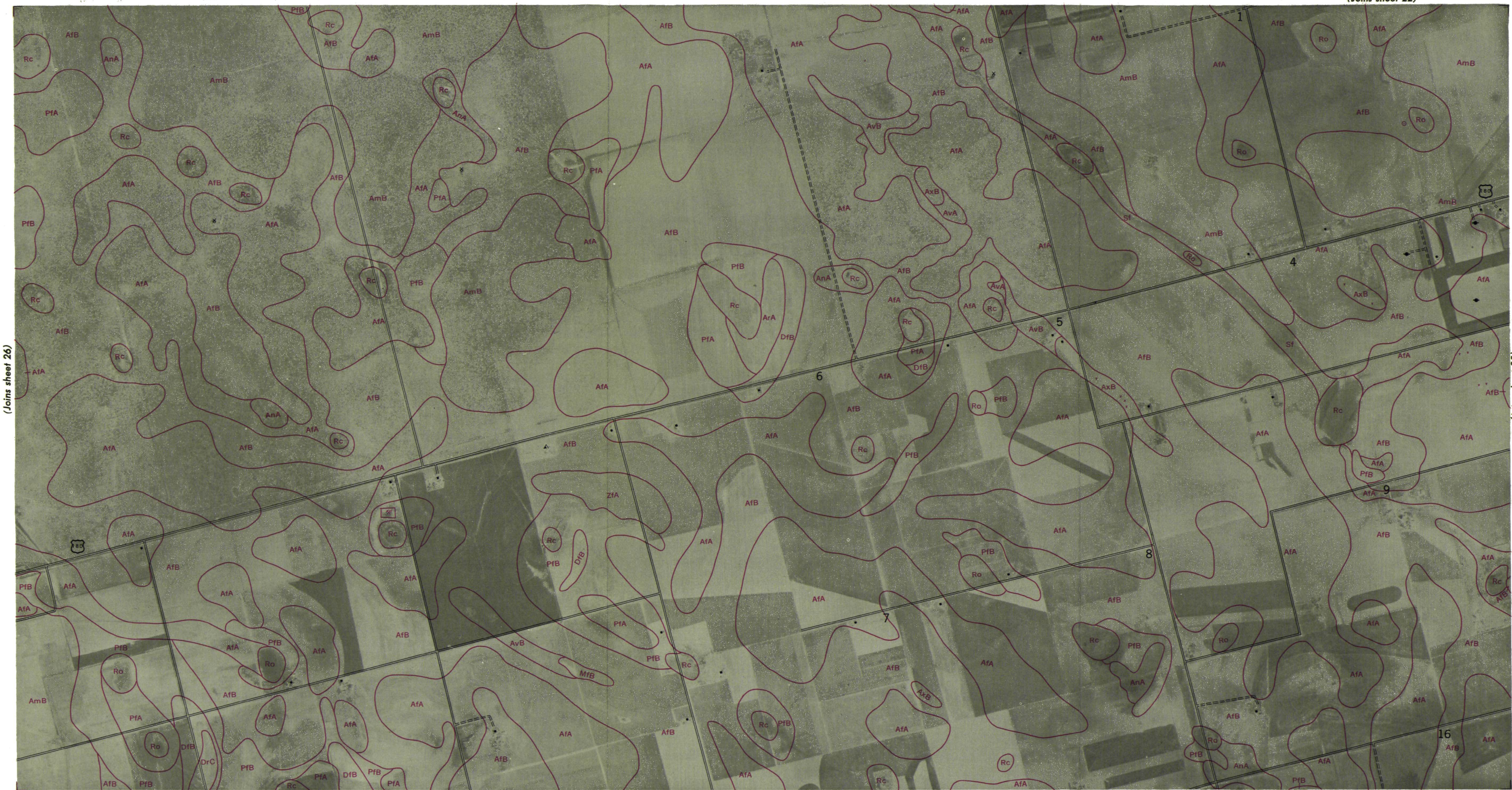
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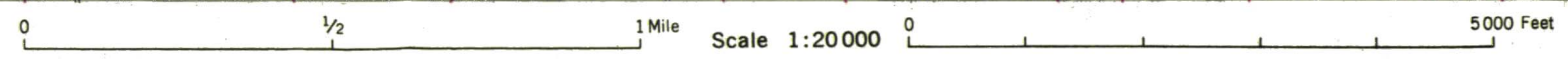
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LAMESA

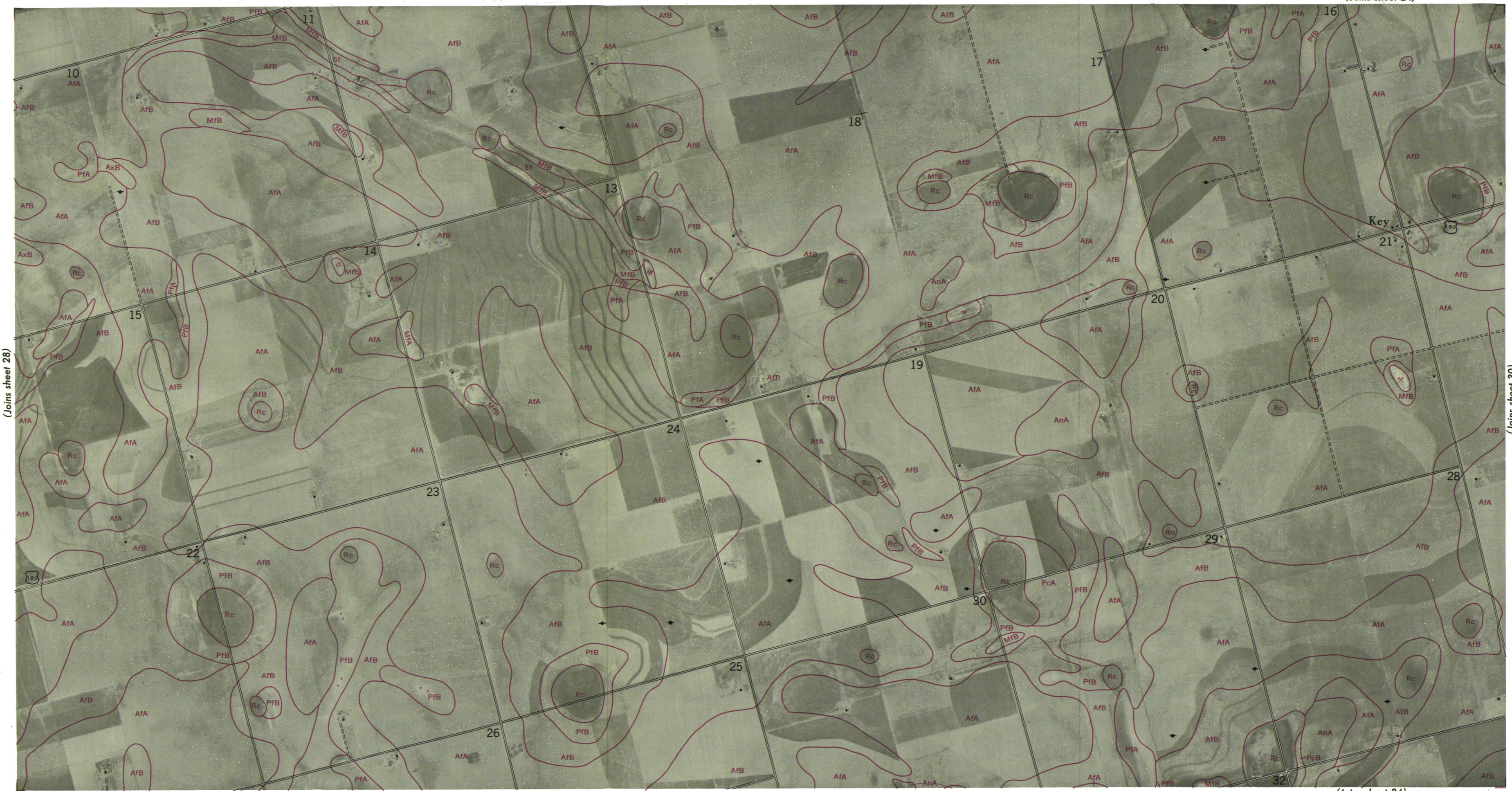
SULPHUR

SPRINGS

DRAW

LAMESA
LABOR HOUSING

DRIVE-IN
THEATRE



0 1/2 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 34)

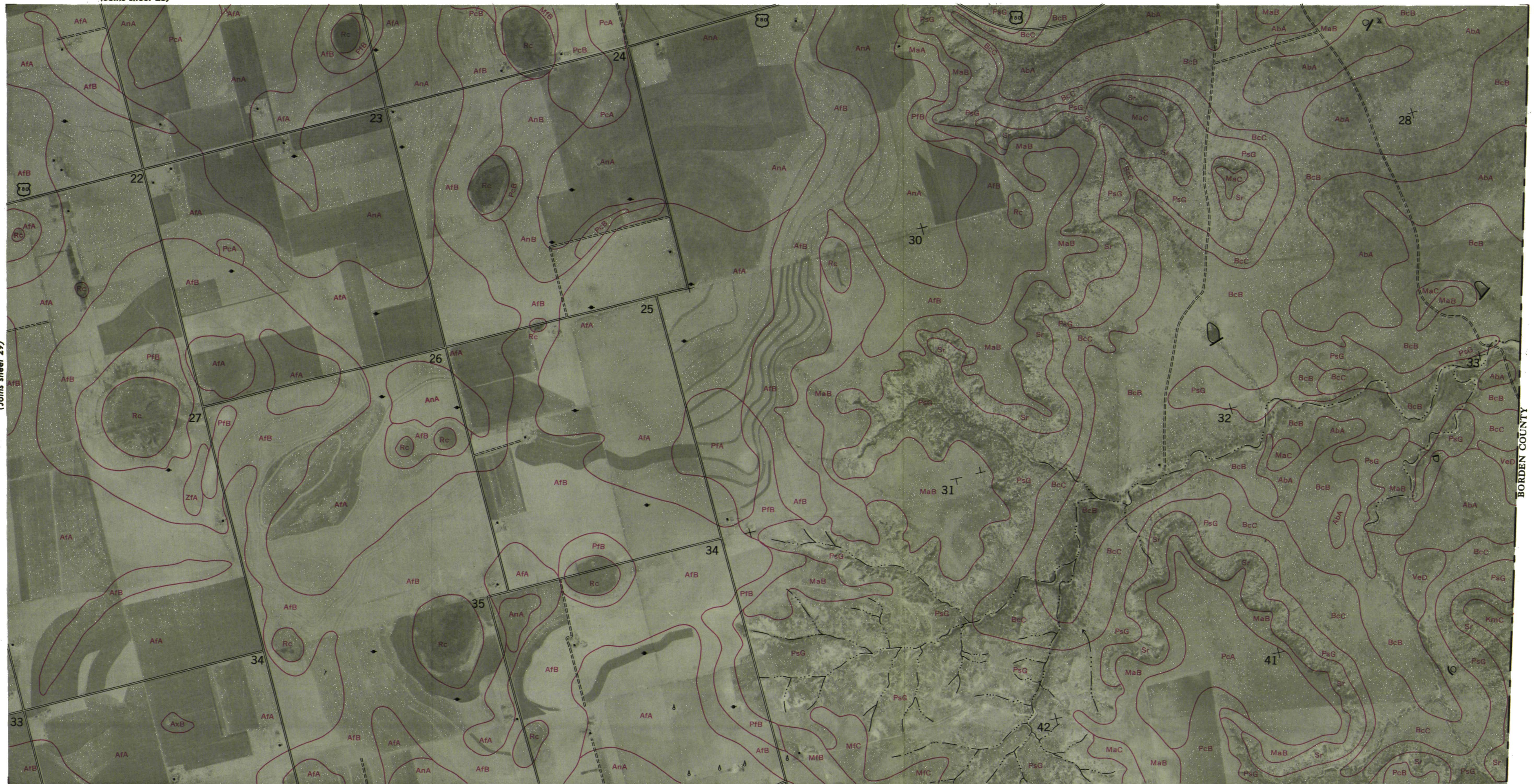
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

section corners shown on this map are indefinite.

(Joins sheet 28)

(Joins sheet 30)

(Joins sheet 29)



(Joins sheet 35)

0 $\frac{1}{2}$ 1 Mile Scale 1:20 000 0 5000 Feet



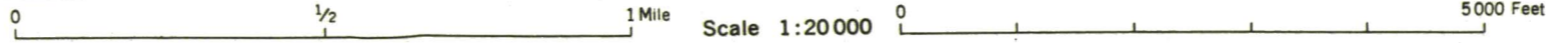
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

Section corners shown on this map are indefinite.

GAINES COUNTY



(Joins sheet 32)



(Joins sheet 27)

(Joins sheet 37)

(Joins sheet 33)



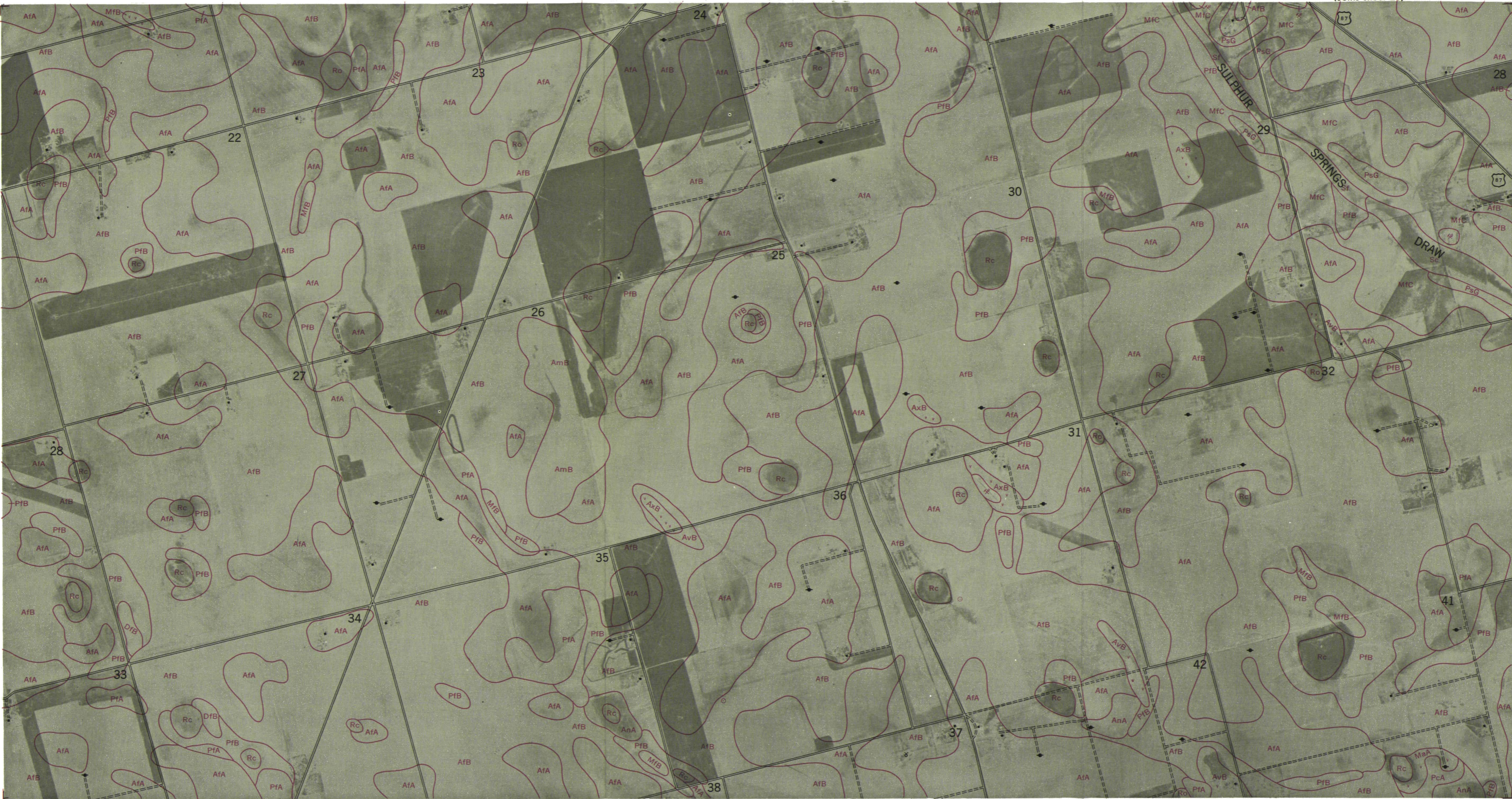
0 1/2 1 Mile Scale 1:20 000 0 5000 Feet



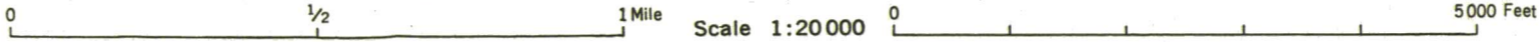
Information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map was compiled from aerial photographs flown in 1951.

Section corners shown on this map are indefinite.

(Joins sheet 32)



(Joins sheet 34)





(Joins sheet 33)

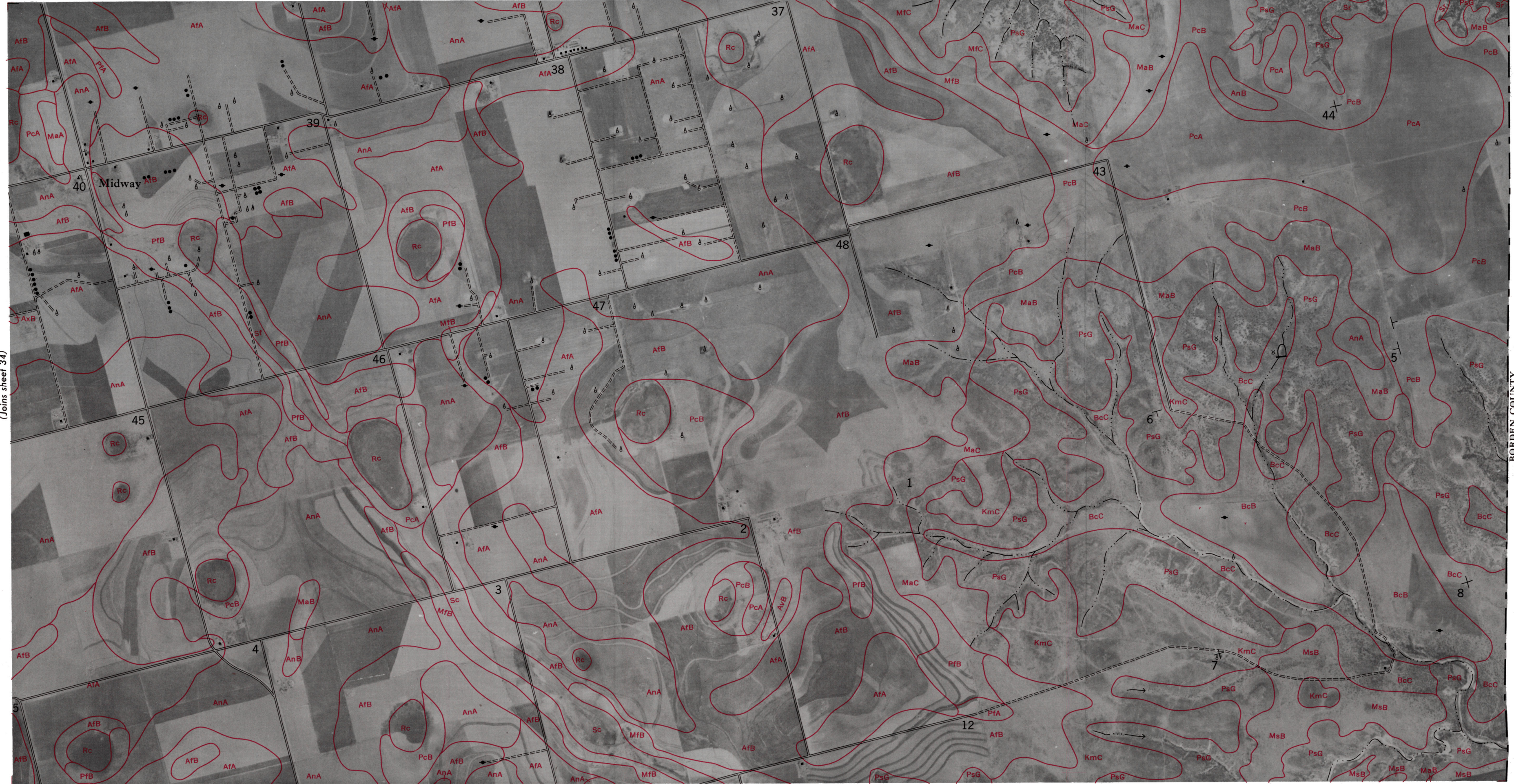
(Joins sheet 35)

(Joins sheet 39)

0 $\frac{1}{2}$ 1 Mile Scale 1:20 000 0 5000 Feet



(Joins sheet 34)



BORDEN COUNTY



GAINES COUNTY

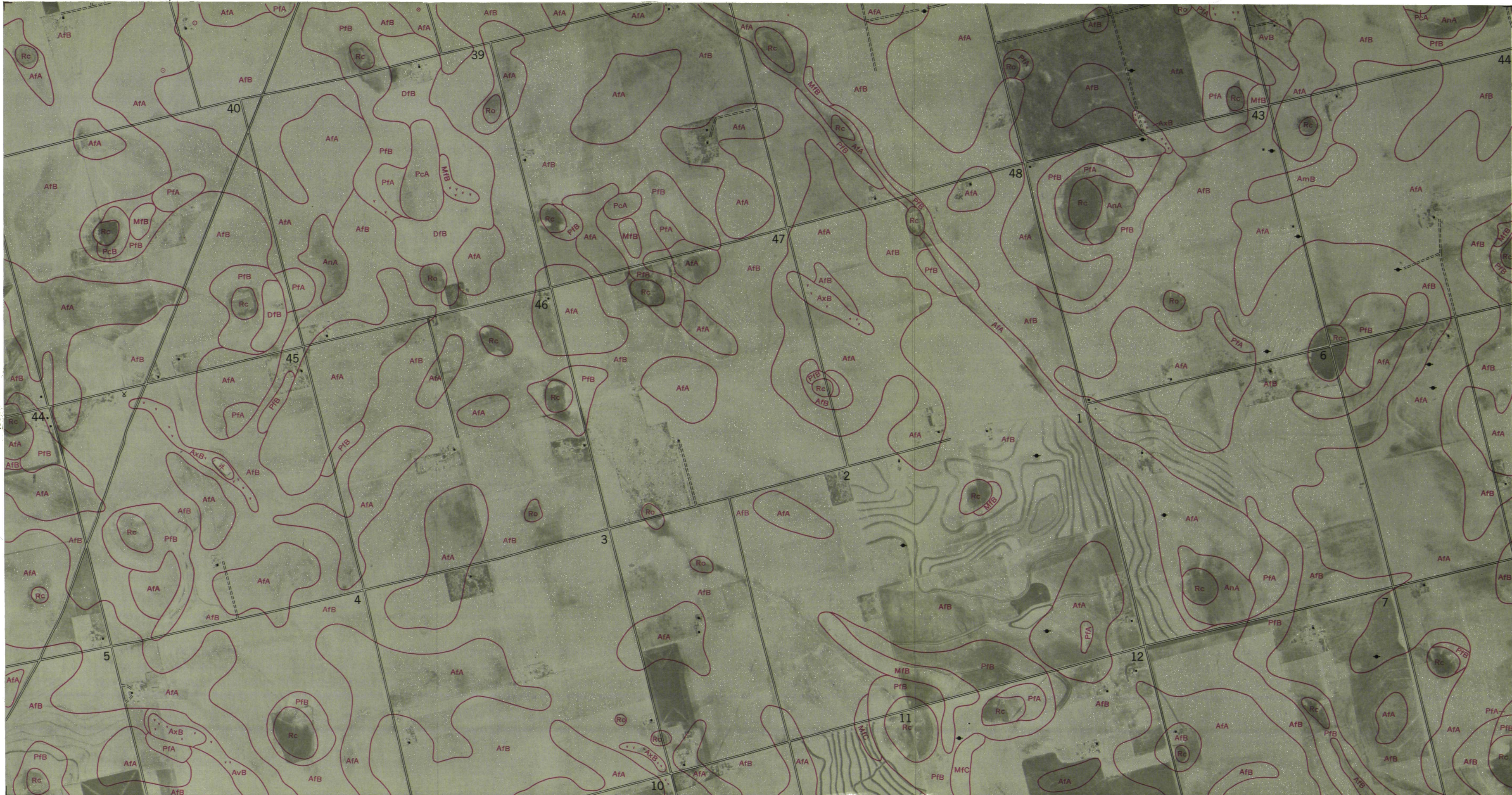


(Joins sheet 37)

section corners shown on this map are indefinite.



(Joins sheet 42)



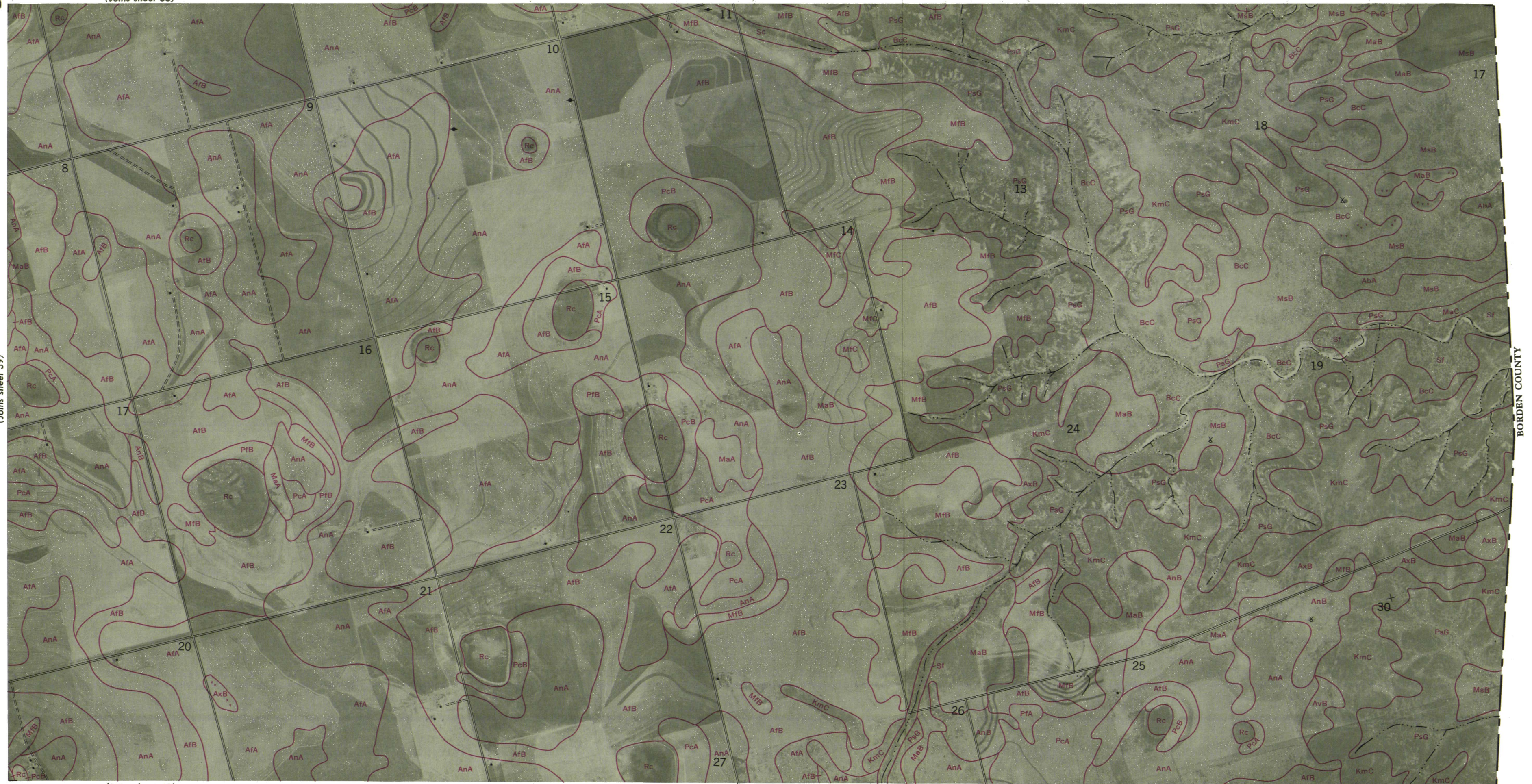
section, corners shown on this map are indefinite.



(Joins sheet 44)



(Joins sheet 39)



BORDEN COUNTY



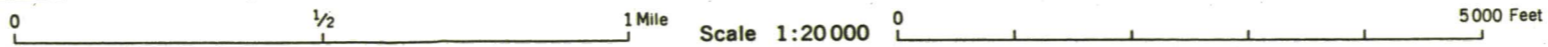
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding this complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

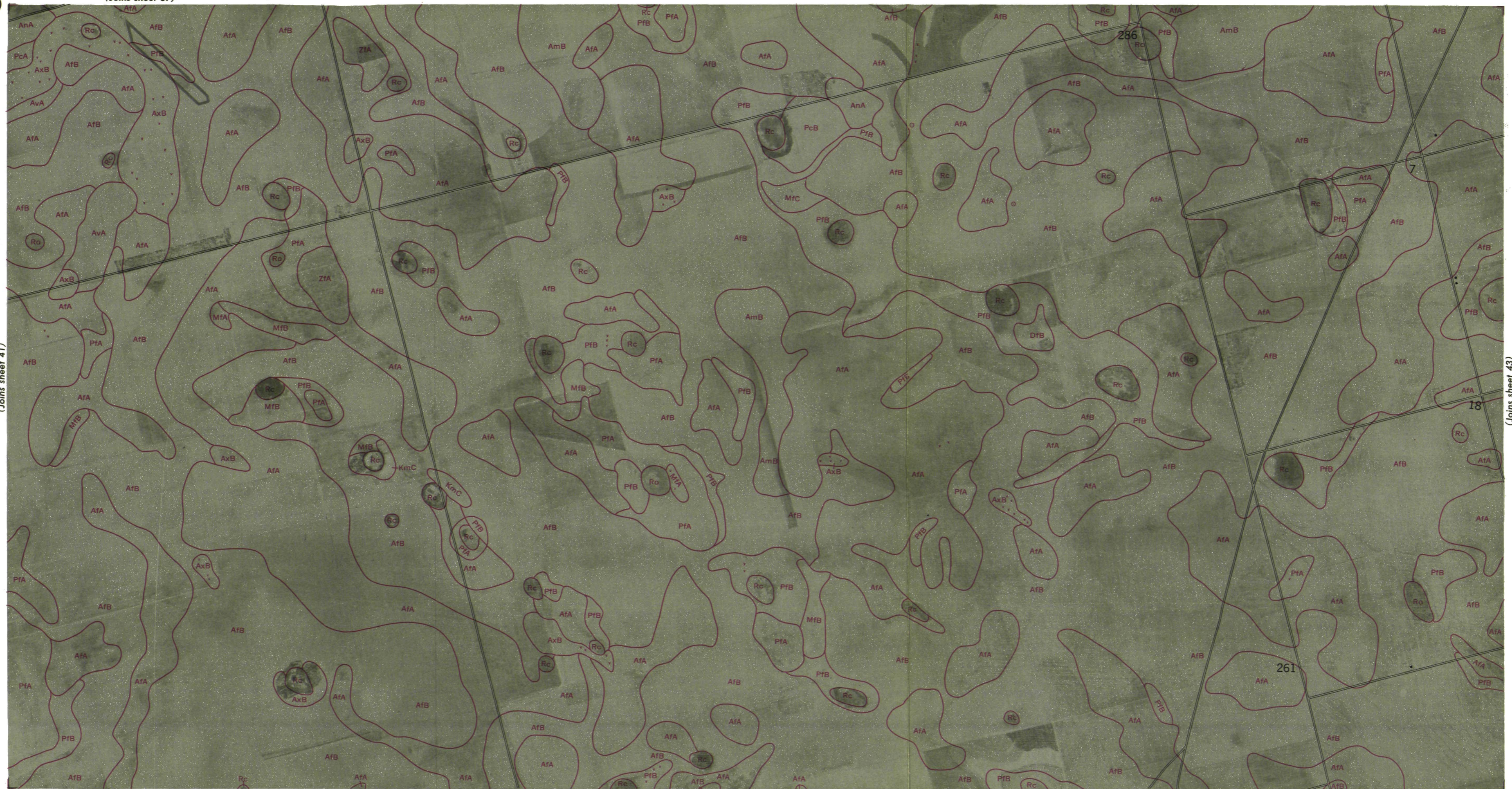
Section corners shown on this map are indefinite.

GAINES COUNTY



(Joins sheet 42)







(Joins sheet 42)

(Joins sheet 44)

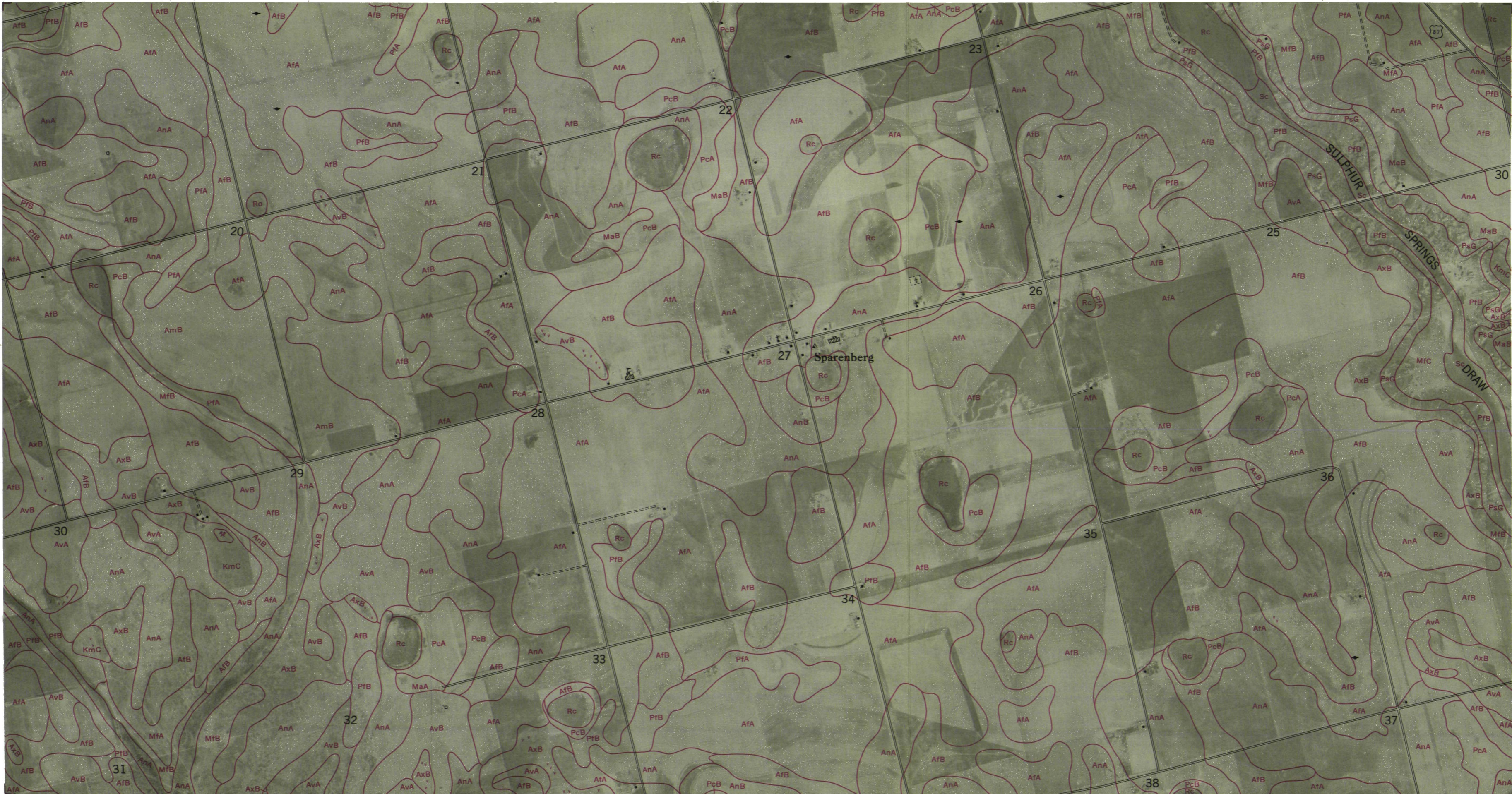
This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

Section corners shown on this map are indefinite.

(Joins sheet 39)

(Joins sheet 45)

(Joins sheet 49)

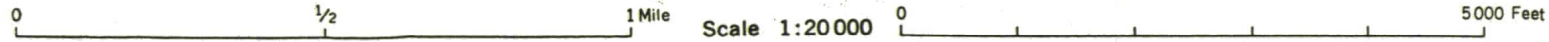
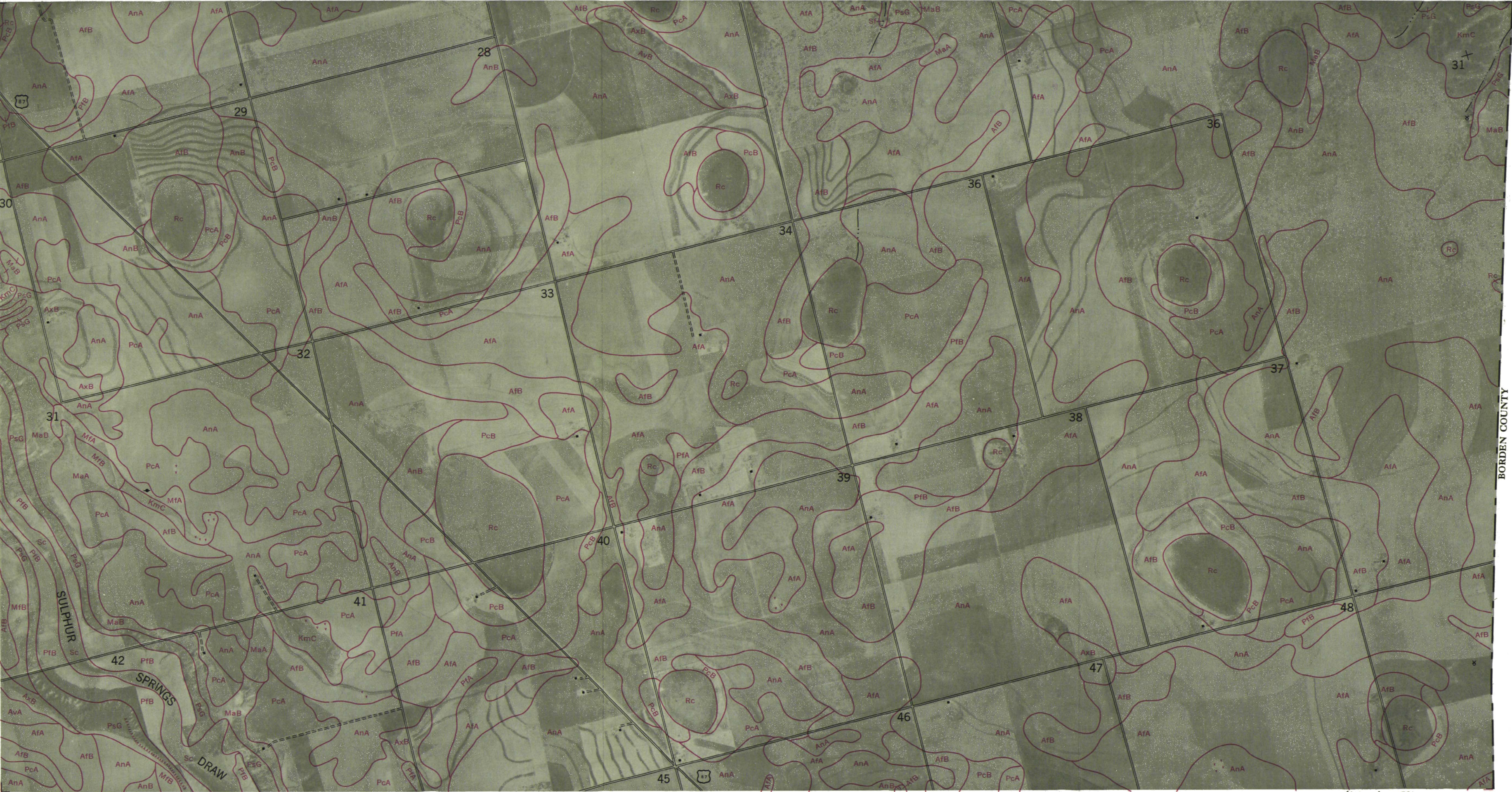




This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

Section corners shown on this map are indefinite.

(Joins sheet 44)



(Joins sheet 41)

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GAINES COUNTY



(Joins sheet 47)



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Section corners shown on this map are indefinite.

(Joins sheet 46)

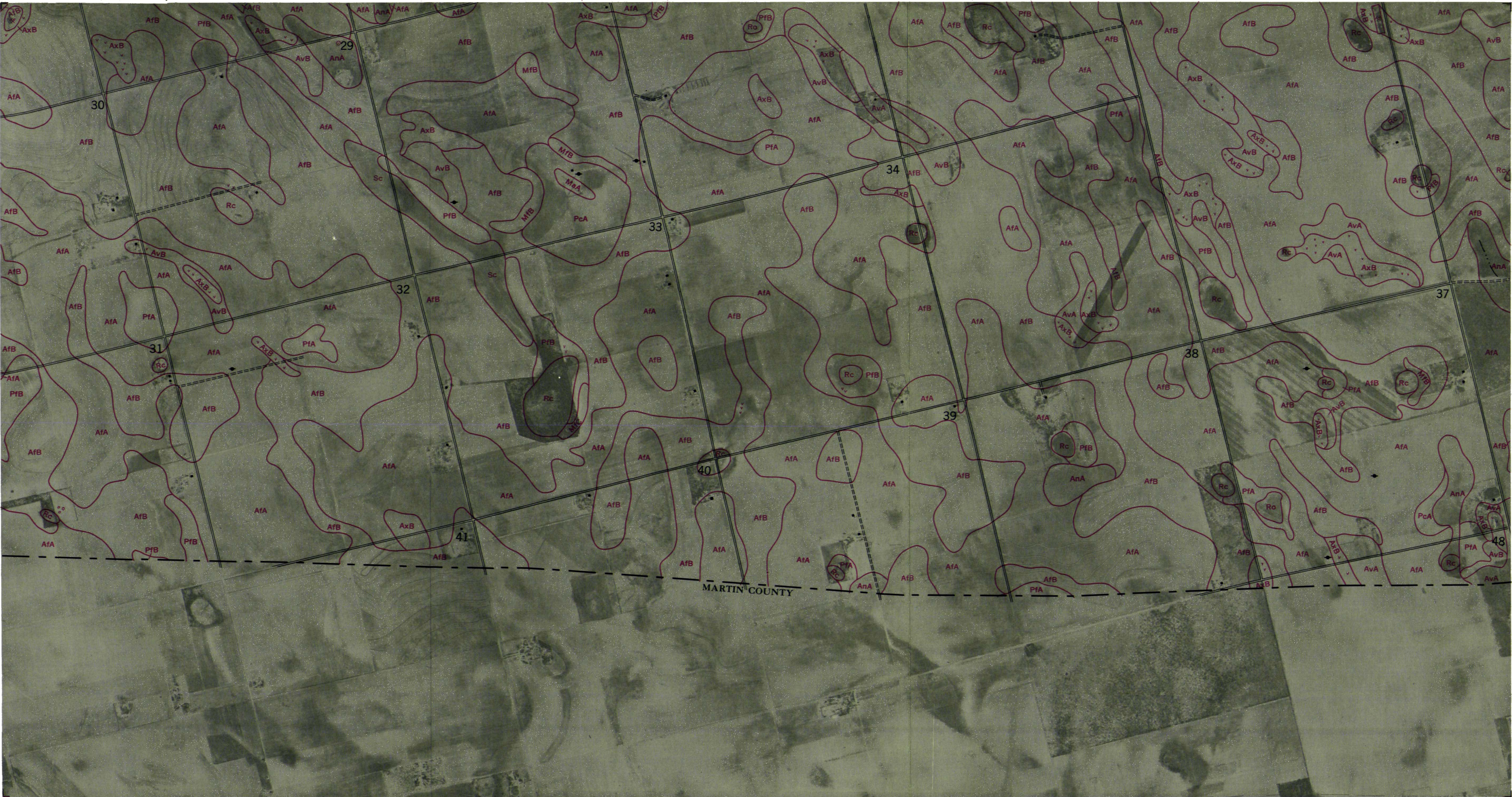


(Joins sheet 48)

(Joins sheet 43)



(Joins sheet 47)



(Joins sheet 49)



This is one of a set of maps prepared by the Soil Conservation Service, U. S. Department of Agriculture, for a soil survey report of this area. For information regarding the complete soil survey report, write the Soil Conservation Service, U. S. Department of Agriculture, Washington 25, D. C. This map compiled from aerial photographs flown in 1951.

Section corners shown on this map are indefinite.

(Joins sheet 48)



(Joins sheet 50)

(Joins sheet 45)

50



(Joins sheet 49)

